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ARMED FORCES CHEMICAL JOURNAL

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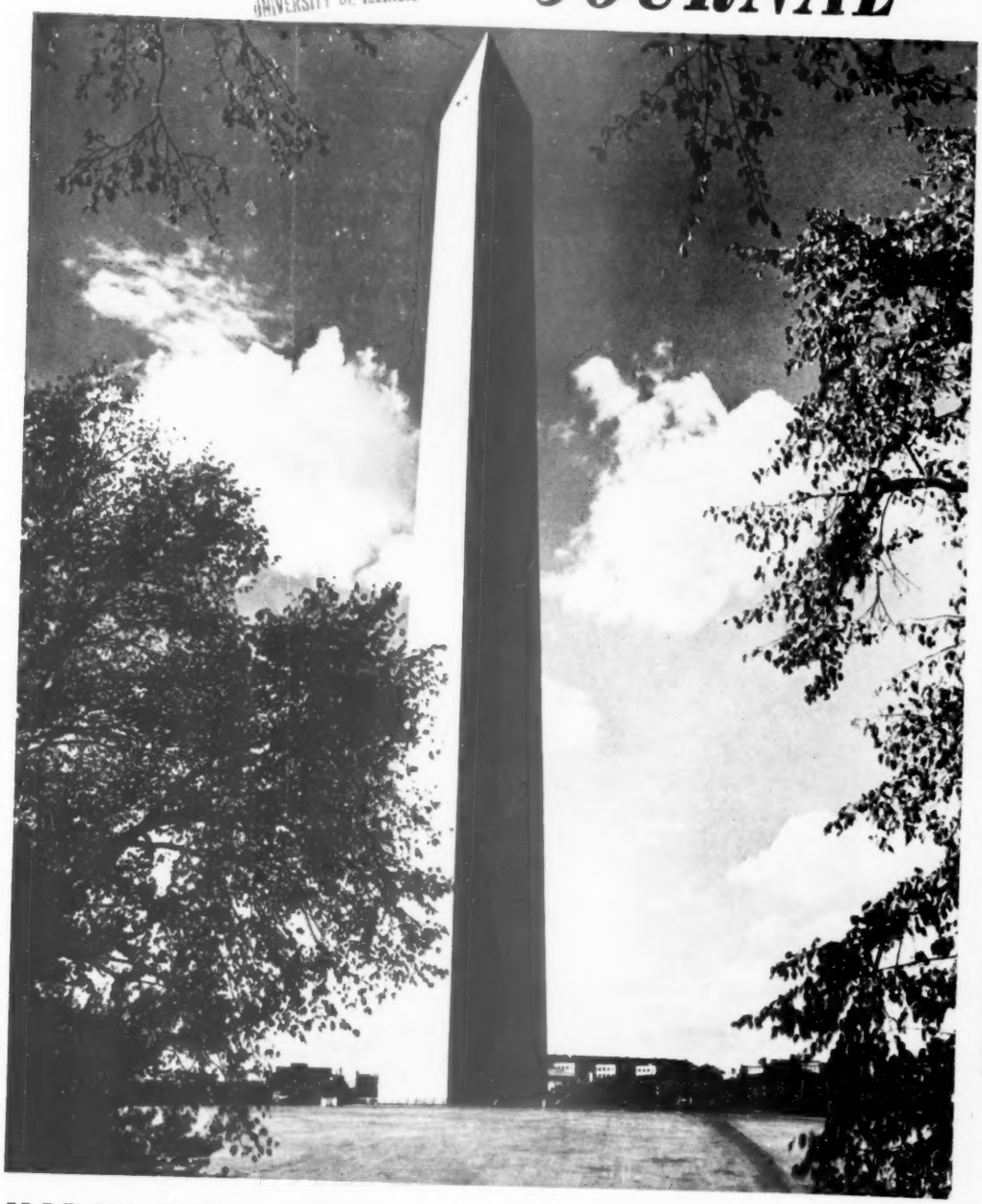


MARCH-APRIL 1957

Helpful answers to CAUSTIC QUESTIONS

As a leading producer of Caustic Soda, Columbia-Southern is asked many questions every month about this versatile, widely-used alkali. While the answers probably are not completely new to every Caustic Soda user, they do re-emphasize certain basic points that shouldn't be forgotten. We hope that you will find this series interesting and helpfully informative.

What is the necessary raw material for Caustic Soda?

Plentiful supplies of brine are required for the electrolytic production of Caustic Soda. This process also liberates Chlorine as a co-product. An electric current is passed through a sodium chloride brine solution contained in specially-designed cells. A 10-12% Caustic Soda solution forms at the cell's cathode. This low concentration liquor is evaporated to yield the various concentrations desired.

Is Caustic Soda an element?

No. Caustic Soda is a compound of sodium, hydrogen, and oxygen. It is known chemically as sodium hydroxide, and is commonly called lye.

How much liquid Caustic is now produced?

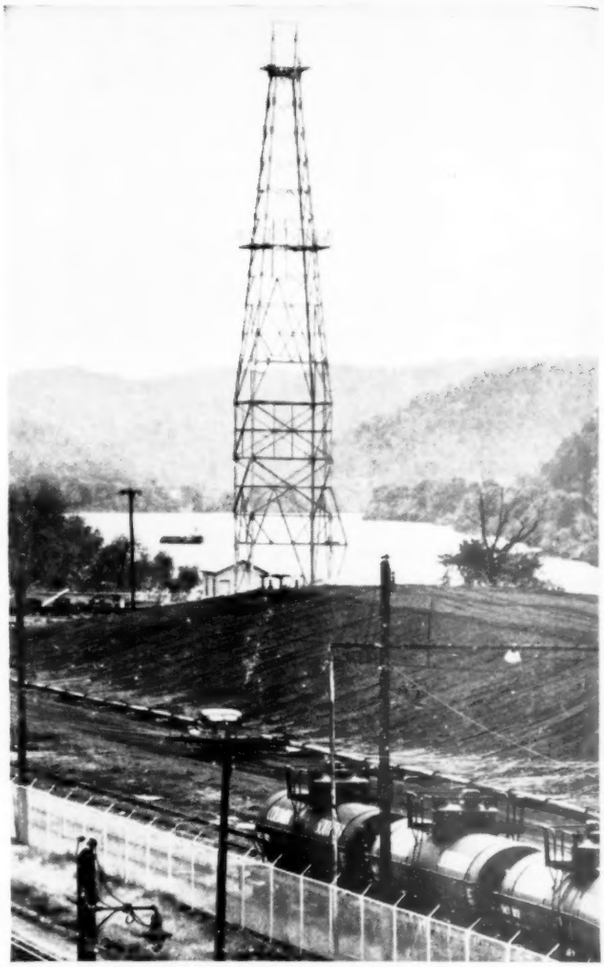
Latest six-month figures for the January-July 1956 period set the production of liquid Caustic at 2,169,368 short tons for electrolytically manufactured, 260,899 short tons for lime-soda process.

What type of pumps are recommended for the transfer of Caustic liquor from tank cars to storage, and from storage to the point of use?

Centrifugal pumps do the job best. All-iron construction with no brass or bronze fittings is generally preferred. For high temperature use, nickel or nickel alloy pumps will give longer service and the liquor will show less metallic contamination.

Who currently uses the most Caustic?

The chemical processing industry itself is by far the largest group user of Caustic, consuming roughly 25% of all production. Rayon and film producers rank second, followed by such large volume consumers as the petroleum refining, pulp and paper, cleaners, soap, textile, metals, vegetable oils, and rubber industries.



SOME OF THE WORLD'S DEEPEST BRINE WELLS, operated by Columbia-Southern to supply the New Martinsville, W.Va., Caustic Soda-Chlorine plant, draw salt brine from depths of a mile and a quarter.

How much water is required to dilute a tank car of 73% Caustic solution to a more easily stored 50% concentration?

About 6,100 gallons of dilution water are needed to bring an 8,000 gallon tank car of 73% down to 50% strength; 7,650 gallons of water to dilute each 10,000 gallon car.

How can each user determine the most economical grade and form of Caustic to buy?

Much, of course, depends upon the user's end product and processing requirements. Solid, standard flake, 50% and 73% solution, all have certain advantages. Processing advances, transportation developments and freight rate changes, however, dictate a periodic review of your purchasing. Columbia-Southern will be happy to look for economies you might well realize . . . at no obligation to you. Call, write or wire our Pittsburgh address for the prompt services of experienced Caustic Soda specialists.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

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The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication.

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COVER PHOTO

Visitors at A.F.C.A.'s 12th Annual Meeting in Washington, D.C., May 22-24, will have opportunity to see and visit some of the great public buildings and monuments of the nation's Capital. Among them is the superb and majestic edifice, distinctive in architectural design and size, the Memorial Monument to George Washington.

Of course, one can admire this structure just by viewing it from the ground, but to appreciate it fully he should also go inside and up to its top. The experience is never to be forgotten; moreover, it is one that can well be repeated. From its observation window, more than 500 feet above ground, the view of urban landscape is unsurpassed.

Built at intervals between 1848 and 1885, from funds derived from popular subscription and Federal appropriations, the monument symbolizes the people's admiration for and gratitude to the Father of Our Country. Standing 555 feet, 5½ inches high, the monument is the tallest building in the City of Washington. A visitor who desires to do so may proceed from the entrance all the way to the top by the stairway, which has 898 steps and 50 landings. Most visitors prefer, by the payment of a charge of ten cents per person (children under 18 free), to use the modern electric elevator, which takes them to the top in 1 minute and 10 seconds.

The Monument is built of Maryland marble; it cost $1,187,710.31.

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ARMED FORCES CHEMICAL ASSOCIATION

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The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

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PRESIDENT'S COMMENTS

12th ANNUAL MEETING OF A. F. C. A.

Our 12th Annual Meeting of the ARMED FORCES CHEMICAL ASSOCIATION will be held this year on May 22, 23 and 24 in the Nation's Capital with headquarters at the commodious SHERATON-PARK HOTEL. The "service host" this year will be the UNITED STATES AIR FORCE.

The slogan for this year's meeting is . . .

"SETTING THE SIGHTS FOR INDUSTRY"

The Program Committee for this meeting, headed by capable Mr. Oliver F. Johnson, AFCA National Vice President for Meetings, has done an outstanding job in packing into this 3-day session many interesting and unusual events.

For more details of the program, I am referring you to another page of this issue. You will find it a well balanced program and well thought out.

One important program detail is the third day which is a classified session limited to persons who have a valid security clearance at the level of SECRET or above. This is our first classified meeting at an annual convention and should be highly important, fascinating and stimulating.

I look forward to seeing you at our—

12th ANNUAL MEETING in WASHINGTON, D.C.

May 22, 23, 24, 1957

Glenn A. Hutt

As SHOWN by the program herein for the 12th Annual Meeting of A.F.C.A., (status as of Feb. 8) the planning is not only well-advanced but, in some cases, both the specific subjects of the presentations and the speakers have already been selected. The Committee on Arrangements is headed by Mr. Oliver F. Johnson, Vice President for Meetings.

The program aims at furthering the military-industrial relationship by indicating areas of development in chemical and allied fields in which Industry may assist the Armed Services and in return giving Industry the benefit of some of the Service planning. The theme for the meeting has therefore been called "Setting the Sights for Industry."

The U. S. Air Force is to be the "host-service" for the meeting this year. The Air Force part of the program will be provided largely by the Air Research and Development Command, headed by Lt. General Thomas S. Power. While the detailed subject matter and names of speakers for the Air Force part of the program have been selected, in view of the possibility of several changes, it has not been deemed practicable to publish details in this issue.

In the case of the Army, an extensive program, under the direction of the Chief of Army research and development, is being finalized. But, there also, the details were not available at the press time of the Journal.

The Navy program for the meeting is now complete.

A.F.C.A. Headquarters is sending to each member a printed "flier" or bulletin giving the program to date, further instructions as to registration.

As previously announced, the meeting this year will include an extra day for a classified program at Andrews Air Force Base. In addition to the Air Force, both Army and Navy will participate in the full day of presentations and exhibits. The session is for members or designated representatives of group member companies who already have valid security clearances at the level of SECRET or above. New security clearances solely for the purpose of attending this meeting cannot be undertaken.

Persons who desire to attend should submit applications by letter on or before 15 March 1957, stating:

Full name (not initials) of the member

Date of Birth

Place of Birth

Full name and address of facility where presently employed

Information on current clearance, including degree of clearance, when cleared, and name of granting agency.

Requests for authority to attend should not be sent to this Association but to—

Industrial Security Office, Office Chief Chemical Officer, Army Chemical Center, Maryland.

Notification of action upon applications will be made direct by the Security Agency.

It will be necessary for those attending this session to present their 12th A.F.C.A. Annual Meeting registration receipts.

ARMED FORCES CHEMICAL ASSOCIATION
12th ANNUAL MEETING
Sheraton Park Hotel—Washington, D.C.

May 22-23-24

Theme: "Setting the Sights for Industry"

PROGRAM
(Status of Committee Plans—Feb. 1957)

May 22—Wednesday

9:00 A.M. - 12:45 P.M. .....Registration
9:00 A.M. - 12:00 Noon .....Coffee
10:00 A.M. - 12:00 Noon .....Board of Directors Meeting
1:30 P.M. - 2:30 P.M.....General Meeting-Awards-Announcements
2:30 P.M. - 5:00 P.M.....**Army Chemical Corps** Series of presentations and skits by senior officials on research and development, engineering, testing, procurement and other subjects.
6:30 P.M. - 7:45 P.M. .....**Cocktail Party** Music by AF String Ensemble

(Evening left open for Company parties or other plans)

May 23—Thursday

Morning Session.....**Air Force Presentations**

9:00 A.M. - 9:10 A.M. .....Welcoming Address by Lt. General Thomas S. Power, Commanding General, Air Research and Development Command.
9:10 A.M. - 9:30 A.M.....Address on Mission and Functions of ARDC.
9:30 A.M. - 10:10 A.M.....Talk—"How to Get to Us"—dealing with Air Force-Industry contact procedures and relationships.
10:10 A.M. - 10:50 A.M. ......"Proprietary Rights"—Discussion, of special interest to Industry, of this question, including its treatment in new Regulations.
11:10 A.M. - 12:00 Noon.....Paper on Chemistry of Space Flight, or other chemical matters of special concern to the Air Force.

Afternoon Session—Army and Navy Presentations

1:00 P.M. - 2:50 P.M.....**Army** — Presentations respecting overall interests of the Army—details of program being finalized.
3:10 P.M. - 5:00 P.M.....**Navy** — Dr. L. W. Butz, Office of Naval Research, Chairman for the Navy Program:
Bureau of Yards and Docks — Capt. A. S. Klay, USN, "Problems of Plastics, Protective Coatings, Soil Treatment and Preservatives."
Bureau of Ships — Capt. B. F. Bennett, USN., "Current Bureau of Ships Problems in Materiel Development."
Bureau of Aeronautics—Mr. T. F. Somers, "Chemistry, Present and Future, for Naval Aircraft."
6:30 P.M. - 7:45 P.M.....**President's Reception and Cocktail Party** Music: AF Jumping Jacks.
7:45 P.M.—**Grand Banquet**—Presiding, Mr. Glenn A. Hutt, President of A.F.C.A.
Guest Speaker—(To be announced later)
Music: AF Strolling Strings
Singing Sergeants
Bagpipers-String Ensemble

May 24—Friday—Special Classified Program at Andrews Air Force Base: Presentations and Exhibits by Air Force, Army and Navy.

7:00 A.M.....Special Buses Leave Hotel for Andrews AF Base
8:00 A.M. - 8:30 A.M.....Coffee at Exhibit Area
9:00 A.M. - 12:20 P.M.....**Air Force Presentations**: Series of talks by various speakers dealing with: Human Factors problems; Materiel problems; Munitions problems. Dr. Amos G. Horney, of ARDC, will conclude Morning Session with talk — "Look Into the Future."
12:30 P.M. - 1:30 P.M.....Luncheon—served at Exhibit Area
1:30 P.M. - 1:50 P.M. .....**Thunderbirds**—Demonstration by AF acrobatic precision flight team.
2:00 P.M. - 3:30 P.M.....**Navy Presentations**: Dr. Butz presiding—
Bureau of Ships — Commander C. M. Sturkey, "Shipboard Aviation Fuel Contamination and Other Current Bur. of Ships Problems."
Bureau of Aeronautics—Dr. H. W. Gilbert, "Chemistry, Present and Future, for Naval Aircraft."
Bureau of Ordnance—(1) Dr. W. E. Land —"Problem Areas in Explosives Systems"; (2) Mr. W. E. Mitchell—"Chemical Problems in the Propellants Field."
3:50 P.M. - 5:20 P.M.....**Army Presentations** (Program being finalized)
5:30 P.M.....Board Bus to Hotel

LADIES' PROGRAM

May 23—Thursday—(Tentative)

9:00 A.M. - 12:00 Noon.....Special bus tour of Washington with stops for visits to: The White House; The Freer Art Gallery; Smithsonian Institution to see display of Inaugural Ball dresses worn by wives of Presidents, and special glassware exhibit.
12:00 Noon.....Luncheon and style show at a Country Club (Special charge $3.50)
Afternoon visit to National Art Gallery and Capitol Building; tea at a foreign embassy, as time may permit.

A.F.C.A. 12th ANNUAL MEETING CHARGES

General Registration and all events, per person...$20.00
Cocktail Party and Banquet for guests of those who are registered, per person..... 15.00

Military Personnel in uniform:
General Registration and all events..... 15.00
Cocktail Party and Banquet on May 23 only.. 10.00

Classified Meeting—Andrews AF Base May 24:
The General Registration ($20) includes attendance by duly authorized persons at the classified session on May 24.
It will be necessary for those attending the classified session to present their 12th A.F.C.A. Annual Meeting registration receipts to the Security Officer in charge of the meeting at Andrews Air Force Base.

Ladies Program:
Separate charge for special luncheon, per person 3.50

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MAGNESIUM METALS

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

U.S. Army Photo

Some of the members and guests of the Baltimore Chapter, in a recent night tour of the plant of Pemco Corporation, manufacturer of porcelain enamels, ceramic glazes and glass colors, are shown here observing an 1800 pound batch tank of the silicate raw materials lifted to where it will be blended and then smelted at 2200° Farenheit.

BALTIMORE CONSIDERS MERGER WITH ACC: VIEWS PEMCO PLANT

Approximately 75 members and guests were present at the dinner meeting of Baltimore Chapter at Hasslinger's Restaurant on November 29. Mr. George L. Cole told of the recent meeting of the Executive officers of Baltimore and Army Chemical Center Chapters for consideration of a proposal to merge the two chapters. A committee composed of Mr. Cole and Mr. R. H. Turk, III, of Baltimore, and Mr. Edmund Schwankey and Dr. L. Wilson Greene, of Army Chemical Center, has been appointed to study the question preparatory to a poll of the membership of each chapter on the merger proposal.

Brig. General Marshall Stubbs, Commanding General, Army Chemical Center, gave a brief talk following which the group proceeded to the plant of Pemco Corporation in Baltimore for a most interesting night tour of the plant. Before the tour the group viewed a film covering the manufacture of porcelain frit.

MONSANTO RECEIVES RESERVE AWARD

The Monsanto Chemical Company, St. Louis, Mo., has received the Reserve Award of the Department of Defense for the Company's "outstanding cooperation with the Reserve Program of the Armed Forces." The citation was presented by the Honorable Carter L. Burgess, Assistant Secretary of Defense, to Mr. Edward W. Gamble, regional vice-president of Monsanto, in a ceremony held at the Pentagon on December 19.

The citation noted that the Company gives military leave to employees in addition to annual vacation time and makes up any difference in pay; that employees do not lose seniority when on military leave; and that the Company has published articles in its house organ pointing out the responsibilities of industry as well as its employees in support of the Reserve Program.

NEW POST FOR MR. HINYARD

Mr. James N. Hinyard, A.F.C.A. member, who, as officer of the Chemical Warfare Service, served in the Chief's Office in World War II, has been appointed director of Market Development for American Potash & Chemical Corporation. He will make his office at AP&CC headquarters at Los Angeles. Mr. Hinyard, who holds B.S. and M.S. degrees in chemical engineering from the University of Texas, at Austin, formerly was with Merck & Company, Inc., at Rahway, N. J.

MAJOR GENERAL WALTER C. BAKER

Major General Walter C. Baker, USA-Ret., Chief of the Chemical Corps of the Army during the period 27 May 1937 to 30 April 1941, died at his home in Washington, D. C., on February 19. General Baker was born in Pennsylvania 22 September 1877. He entered the military service in the Spanish-American War in May 1898. He was commissioned in the Coast Artillery of the Regular Army in 1901 and served in the Field Artillery of the National Army during World War I. He transferred to the Chemical Warfare Service (now the Chemical Corps) on 2 December 1920. He had been awarded the Distinguished Service Medal when he retired in 1941. General Baker was an Honorary Life Member of the Armed Forces Chemical Association and had been active in the Washington Chapter.

WILMINGTON HEARS BRITISHER SPEAK ON THE MIDDLE EAST

Mr. William Morris, First Secretary of the British Embassy, Washington, D. C., was the guest speaker at Wilmington Chapter's first meeting of 1957 on January 22. Members report that Mr. Morris gave a stimulating talk on the Middle East situation from the British standpoint which was followed by a lively discussion. The speaker was introduced by Mr. H. T. Clark, Chapter Vice President.

Mr. F. H. McBerty, Chapter President, presided at the meeting, which was attended by some 45 members and guests. He announced the appointment of Mr. W. F. Jackson, of the DuPont Company and Mr. R. J. Reilly of Atlas Powder Company, as a membership committee.

Mr. W. W. Hess submitted the request from A.F.C.A. National Headquarters for Wilmington Chapter to join with New York in co-sponsoring the 1958 annual meeting at Atlantic City. A motion to accept this proposal was adopted.

GEORGIA TECH CHAPTER ELECTIONS

The new officers of the Students' Chapter of A.F.C.A. at the Georgia Institute of Technology, Atlanta, Georgia, are the following: Mr. E. Harry Brown, Box 2364, President; Mr. Lee Neel, Box 2546, Vice President; and Mr. Richard O'Bryant, Treasurer.

NEW TECHNICAL MAGAZINE

Under the title, "data," a new monthly magazine, featuring scientific and technical developments in the Armed Forces and other government agencies, has commenced publication. The editor is Mr. Murray Smith, formerly a naval officer, the magazine being an outgrowth of a former naval publication "Navy Technical News," which he edited while on active duty. The Navy Technical News is no longer published.

A special feature of the service to subscribers is the listing of sources of articles and a provision to interested readers, on request, of the magazine's source material. The publication's office address is Box 6026, Arlington 6, Virginia. Subscription rates are $12.00 per year.

CHEMICAL CORPS DEVELOPS NITRIC ACID TRAILER FOR AIR FORCE IN FUELING GUIDED MISSILES

A group of 20 Air Force technicians recently completed training with a new 1500-gallon special trailer designed by the Chemical Warfare Laboratories at the Army Chemical Center, Maryland, for more efficient handling of fuming nitric acid in fueling guided missiles.

How to fill the fuel tanks of guided missiles and rockets at launching sites in the field without endangering personnel has been a problem since the advent of these new weapons. A cooperative research and training effort by the Air Force and the Army Chemical Corps has produced the solution. The military and civilian technicians in this group will serve as guides to others in the special techniques required.

Special handling techniques for nitric acid are necessary because its fumes are poisonous. Fires or explosions could result if the acid touched organic material so, in addition to body protection, the spills must immediately be flooded with water.

The new trailer, made of stainless steel to resist corrosion, contains a pump of special design that allows both filling and emptying of the missile tanks, and is equipped to neutralize any escaping fumes during filling operations. Special packing and lubricants are used to prevent fires or explosions.

Mr. W. Paul Henderson was responsible for the design phase of the cooperative project, and Mr. Earl S. Kelly for the production phase. The training program was conducted by Mr. Norman A. Weisgarber and Mr. Henderson.

U.S. Army Photo

Students operating nitric acid trailer during practice run. The man at left is prepared to flood any accidental spill with water.

HARSHAW

Synthetic

OPTICAL CRYSTALS

• The rapid development and extensive application of instrumental analysis has been made possible to a large extent through the infrared and ultra-violet transmitting optics supplied by Harshaw Chemical Co. The development of the process for growing large size crystals and the production of these synthetic crystals commercially are among the Harshaw Laboratory's important contributions to science.

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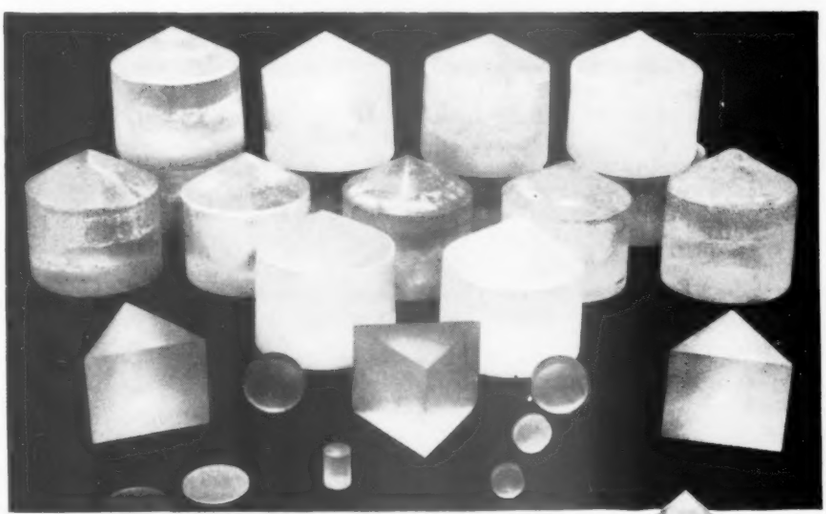

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AIR FORCE IN THE INTERNATIONAL GEOPHYSICAL YEAR

Milton Greenberg and
Dr. Alan M. Gerlach
Geophysics Research Directorate
Air Force Cambridge Research Center

(Following is a condensation of an article (revised by the authors February 1957) published in the Spring 1956 issue of the Air University Quarterly Review; reprinted here by permission of the Editors.)

Just as the bull fiddler looks with envy on the piccolo player when it comes to carrying instruments, so the geophysicist envies the scientist who can carry his instruments with him, or, worse yet, is able to pursue a lifetime of investigation without stepping outside his laboratory.

Ideally the geophysicist should travel everywhere, including outer space. This is true because the object of inquiry of the geophysicist is the earth, its land and water surfaces, and its atmosphere; the other planets and stars, especially the sun; and the outer space which contains them. In other terms the broad field of geophysics includes the sciences of meteorology, oceanography, terrestrial physics, atmospheric physics and chemistry, ionospheric physics, solar and stellar physics, and space physics.

It is generally characteristic of these sciences that the primary way to investigate them is to go out into nature and study the physical, chemical, and electrical processes as they occur. Of course there are exceptions. But the basic empirical data which give rise to theories must be obtained in the vast, possibly limitless, universe of nature. To this must be added the complication that since many geophysical phenomena are interrelated and interdependent, they must be observed simultaneously and on a large scale. It is these facts which make geophysical investigations so difficult, time-consuming, and expensive.

THE INTERNATIONAL GEOPHYSICAL YEAR

The purpose of the International Geophysical Year (IGY) from July 1957 to December 1958 is to plan and carry on research in the geophysical sciences on an international cooperative basis. Some fifty-five countries have developed plans for participation in the IGY. This is gratifying to the scientific world, both civilian and military, since in so many of the research areas the simple-minded "practical applications" are neither evident nor imminent.

IGY is the third international scientific year. The first was held in 1882-1883 and was called the First International Polar Year. Plans were then formulated to conduct similar programs at 50-year intervals. The Second International Polar Year was held in 1932-1933, despite the economic depression. These efforts were primarily geophysical explorations of the North Polar regions.

Because of the rapid advances in scientific techniques, the developing needs for additional information, and the routine availability of new modes of transportation, a group of American scientists suggested in 1950 that a third polar year be conducted in 1957-1958, after a 25-year, rather than a 50-year interval. Formal action was taken in 1950 by the Mixed Commission on the Ionosphere to present this proposal to the International Council of Scientific Unions (ICSU). The proposal was endorsed by the International Union for Scientific Radio, the International Astronomical Union, and the International Union of Geodesy and Geophysics. The International Council of Scientific Unions set up a Special Committee in 1952 (Comité Special de l'Année Geophysique Internationale (CSAGI)) and invited the countries supporting the International Council, and the Soviet Union, to form national committees to organize their participation in the proposed polar year.

In late 1952 the International Council broadened the proposed program to include the entire world, and con-

MR. MILTON GREENBERG

DR. ALAN M. GERLACH

Both Mr. Greenberg and Dr. Gerlach served as Meteorological Officers of the Air Force in World War II.

Mr. Greenberg is Director of Geophysics Research Directorate of the Cambridge Research Center. Born in Cartaret, New Jersey, he was educated there and at the College of the City of New York, New York University, and Harvard University.

Dr. Gerlach is Chief of the Program Planning Section, Programs Branch, of the Cambridge Center. He was born in Milwaukee and educated at Marquette University, University of Chicago, Institute of Tropical Meteorology of the University of Puerto Rico, and Harvard University.

Mr. Greenberg and Dr. Gerlach are both members of the American Meteorological Society, and the American Rocket Society.

sequently redesignated the effort the "International Geophysical Year." An augmented Special Committee met for its first plenary meeting in Brussels, Belgium, during 30 June-3 July 1953, and established eleven groups to consider programs, proposals, and problems. These included one on publication and ten on scientific areas: (1) meteorology, (2) latitude and longitude determination, (3) geomagnetism, (4) ionosphere, (5) aurora and airglow, (6) solar activity, (7) cosmic rays, (8) glaciology, (9) oceanography, and (10) world days. To these the second plenary meeting of the Special Committee in Rome during 30 September-4 October 1954 added: (11) rocket exploration of the upper atmosphere, and (12) seismology and gravity. Geographic areas of special effort were defined as the Arctic and Antarctic regions, the tropical zone, and three special meridians (70-80° W., 10° E., and 140° E.).

The Rome meeting also explicitly stated the criteria governing inclusion of programs in the IGY. First priority is given to investigations requiring coordinated synoptic or simultaneous observations over a large portion of the earth. Second priority is allocated to investigations which will be significantly enhanced by the availability of such synoptic observations. The third class comprises those geophysical observations which exploit the occupation or establishment of stations in relatively unexplored areas for some other, primary purpose. Finally, observations are to be made of slowly varying geophysical phenomena, for comparison with similar past and future observations during different epochs.

U. S. PARTICIPATION

THE U. S. National Program, which has been coordinated with the programs of other countries, includes activities in each of the proposed scientific and geographical areas. It was developed by the U. S. National Committee for the IGY (USNC-IGY), established by the National Academy of Sciences-National Research Council, under the chairmanship of Prof. Joseph Kaplan of U.C.L.A.*

As the Committee has increasingly been concerned with the implementation or actual operation of the planned national program, its technical panels have been turning to the universities, observatories, private institutes, public agencies, and the Department of Defense for assistance. In the Light of DOD guidance the three services are cooperating with the IGY by affording two kinds of assistance: first, logistic support—for example, the provision by the Navy of ships and construction crews for the Antarctic expeditions; and, secondly, direct participation in the scientific program. The Air Force, as also the Navy and Army, has accepted responsibility for implementing certain portions of the proposed program. The Air Force IGY programs are in the most cases expansions of or complements to the existing and planned projects of the Geophysics Research Directorate, Air Force Cambridge Research Center (AFCRC), of the Air Research and Development Command.

Perhaps the two most striking undertakings in the U.S. National Program are the Antarctic Expeditions and the Upper Atmosphere Explorations by research rockets and earth satellites to challenge man's last physical frontier—space.

Antarctic Expeditions

Twelve nations are scheduled to man 57 stations in Antarctica to carry on the international scientific program on that continent. The U. S. Antarctic program ("Operation Deepfreeze") will be carried on at six scientific stations—Little America, Byrd, South Pole, Weddell Sea (Ellsworth Station), Knox Coast (Wilkes Station), and Adare (with New Zealand)— supported by the McMurdo Sound logistic station (Williams Air Operations Facility). The Little America station is the major U. S. Base. The South Pole station is being established primarily by airlift operating out of McMurdo Sound, which itself is supplied by Air Force airlift from Christchurch, New Zealand, over 2250 miles of desolate ocean and pack ice.

The American Antarctic scientific program will include investigations in eight scientific areas. Since all American scientific stations are within or near the auroral zone, an extensive auroral observation program is planned, using patrol spectographs, all-sky cameras, visual observation, and scanning spectrometers. Observations with identical equipment at Northern Hemisphere counterpart stations will permit investigations into the simultaneity of auroral phenomena in the two hemispheres. Visual and low power radar observations of meteors will also be undertaken in Antarctica.

The Air Force Cambridge Research Center is providing both the Deputy Chief Scientist of the Antarctic program, who is also the project leader for the glaciology, seismology, and gravity programs in the Antarctic; and the project leader for the Antarctic aurora and airglow program. The Deputy Chief Scientist will winter over at the Little America station and will be responsible for actual field administration.

Arctic Program

The U. S. National Committee is at present formulating an Arctic regional program with emphasis on meteorology, oceanography, glaciology, and auroral and ionospheric physics. The Air Force through its Alaskan Command and Northeast Air Command will provide logistic support to two Arctic Basin ice floe stations and to all IGY activities at Thule Air Base.

Upper Atmosphere Explorations

The common use of rocket vehicles for carrying scientific instrumentation into the high atmosphere had its beginning in the American firing of captured German V-2 rockets after World War II. Because of their limited numbers and expense, the V-2's were followed by Aerobee and Viking rockets, developed specifically for research purposes. These rockets have generally been fired from Holloman Air Force Base, New Mexico. The almost complete restriction to the atmosphere above New Mexico has produced scientifically incomplete data.

One way to overcome this limitation is to establish additional rocket launching facilities for firing existing types of research rockets. A more economical approach is to develop a simple rocket probing system which will be independent of special ground installations. The "ultimate," but expensive, capability is the earth satellite.

Rocketry Program

When the planners of the original American IGY upper atmosphere research program made their decisions in January 1954, they had no advance knowledge of U. S. Government intentions regarding earth satellites, nor of the resolution on satellites which the Special Committee of the IGY would pass in its meeting at Rome in October 1954. They were aware of the capabilities of the Rockoon, the small balloon-borne Deacon rocket fired at the point of maximum ascent of the balloon, and of its limitations of

(Continued on page 31)

* Dr. Kaplan spoke on the IGY at the 11th Annual Meeting of A.F.C.A. in Boston on June 14, 1956. His address was published in the July-August 1956 issue of the Journal.—Ed.

BDSA's CHEMICAL AND RUBBER DIVISION

By UDELL T. GREENE *

ON OCTOBER 1, 1953, Secretary of Commerce Sinclair Weeks announced the establishment of the Business and Defense Services Administration, a primary organization unit in the Department of Commerce. The new agency, which was to continue the residual defense and mobilization functions of the former National Production Authority (NPA), also involved the establishment of 25 industry divisions staffed by business experts from government and private industry "in order to provide a focal point for effective cooperation between government and business in promoting economic stability and growth." The government experts in this new organization were largely the same personnel who had been detailed from the Commerce Department to form initially the nucleus of the NPA.

Defense Functions

The functions of the Chemical and Rubber Division are best described by the name of its parent organization — *Business* and *Defense Services* Administration. In more ways than one, however, the "defense services" are as much an aid to business as to the government. The primary purpose of these defense activities involves plant protection measures against nuclear attack, supply measures after attack to maintain continuity of management and output at undamaged plants, and subsequent reconstruction measures to speed vital damaged plants back into production.

These defense measures involve a variety of national duties which are detailed below:

Expansion Goals and Rapid Tax Amortization—The purpose of the government's rapid tax amortization program, which was born out of the Korean emergency, was to speed up the rate of "normal" expenditures for new plant and equipment. The idea was to have a reserve capacity buildup of strategic commodities which would be of sufficient size to support a guns-plus-butter economy or what is known as a partial mobilization base. Since companies couldn't be expected to install extra capacity which might remain partially idle unless military needs took up the slack, the accelerated tax amortization program allowed the depreciation of certain defense-supporting projects in five years instead of the usual three times that period. The advantage of this program lay in the company's ability to offset recent rapidly-growing rates of plant and equipment obsolescence. With new processes, techniques, instrumentation, products, and uses constantly appearing, the ability to write off capital outlays quickly, in order to keep abreast, was a decided asset.

The only alternative to this rapid tax write-off would be for the government to build its own plants, much as was done during World War II. This would involve subsequent sale of these properties by the government with all its attendant problems. The accelerated tax amortization program was considered by far the more advantageous.

The program works something like this. The government established "expansion goals" for various essential commodities, determining the amount of additional capacity needed above existing levels. The potential productive rate was determined after careful study and measured against the amount of capacity necessary to reach a partial mobilization level. Thereafter, the Office of Defense Mobilization formally established and announced

—Rebman photo

Dr. U. T. Greene, author of the article herewith completed his six-month tour as Director of BDSA's Chemical and Rubber Division at the close of the year 1956 and has now resumed his position in Cleveland as an executive of the Diamond Alkali Company.

A Clevelander by birth, Dr. Greene earned an A.B. degree in chemistry at Hiram College, Ohio, in 1929; received his M.A. at Williams College, Massachusetts in 1931 and was granted a Doctorate at Rensselear Polytechnic Institute, New York, in 1933. During the period 1934-1942 Dr. Greene worked as a metallurgist, successively, with Great Lakes Steel Corp., The Standard Tube Co., both of Detroit, Mich., and the General Electric Co., Pittsfield, Mass. In 1942 he was appointed Chief Chemist of Diamond Magnesium Co., which was organized by Diamond Alkali to operate a government-owned magnesium plant at Painesville, Ohio. When that plant was "moth-balled" in 1945, Dr. Greene was transferred to Diamond's central engineering department, and subsequently joined the Company's commercial development department, becoming its coordinator in 1955.

* Director (July 1-December 31, 1956), Chemical and Rubber Division, Business and Defense Services Administration, U. S. Department of Commerce.

[1] The chemical industry with about 65 expansion goals took a greater than usual part in the government's rapid tax amortization program. From September 1950 through September 1954, some $5.2 billion were spent on new plant and equipment by chemical producers. Of this amount, almost $3 billion, 57 per cent, was certified as essential by the government and about $1.6 billion, almost a third, was subject to quick tax write-off. These rather high proportions were the direct result of the widespread use of chemicals in defense-supporting activities or in direct military requirements. By the end of March 1955, almost nine-tenths of the $3 billion of certified chemical projects was already in place and by now practically all of such projects have been completed. During 1955 and 1956, very little certification activity was evident in the chemical field, with the exception of glycerin, and currently, all chemical goals for rapid tax write-off have been closed. However, these goals are constantly under review to determine whether any capacity shortage is imminent with respect to the combined needs of the military and civilian economy.

an expansion goal with a scheduled completion date. Under various criteria, rules, and regulations, companies were then invited to participate in the expansion by filing applications for certificates of necessity. These certificates are the permits granting a rapid tax write-off after approval of the application.[1]

It is worth speculating a bit as to the future course of the rapid tax amortization program.[2] Obviously, as we progress in time, with the accompaniment of population increases, the expanded base for a mobilization goal covering a specific strategic commodity shortly is overrun by the growth in civilian requirements. If only for this reason, constant vigilance is necessary to determine, for instance whether a capacity goal reached in a particular year may not be overgrown two or three years later. Complicating the picture is the fact that our current capacity goals for meeting military and civilian needs are based on a partial mobilization level. Should full mobilization suddenly occur via an attack which would plunge us into full-scale war, a much larger facility expansion would be essential even with reduction of the civilian take to rock-bottom levels.

However, there is good reason for this partial mobilization approach besides its offering the building blocks upon which to superimpose additional facility expansion. Changes in military policy, constant development of new processes and techniques, improved products, uses, applications, new and cheaper substitute materials all contribute to changes in the size and character of expansion goals for strategic items.

Capacity and End-Use Surveys—Under the provisions of the Defense Production Act of 1950, as amended, our Division conducts, with industry's help, supply and requirement studies of strategic chemical and rubber products. These studies are one of the most important segments of the Chemical and Rubber Division's work. Requirements are surveyed from the standpoint of the various military and essential civilian needs; supply from the standpoint of plant capacity, current production, and imports; major raw materials from the standpoint of quantities necessary to manufacture the specific products; and end-uses from the standpoint of mobilization essentiality.

Through these studies, the Division makes available to industry periodically, without disclosing individual company data, detailed commodity use patterns which furnish the means for a more accurate appraisal of current and future markets. At the same time, the government is furnished with data which provide the basic tools for forming intelligent decisions and policy under conditions of partial or full mobilization. These policy decisions involve proper and equitable allocations to essential users of the particular commodity so as to counteract the unstabilizing effects of emergency conditions on normal market deliveries and operations. This would permit the least stringent curtailment of non-essential uses commensurate with the maintenance of a strong defense economy.

The government also can determine from these data the type and amount of expansion necessary to meet current and future military and essential civilian needs, as well as the extent to which industry can provide such increased capacity. Such expansion may require the granting of certificates of necessity for plant erection under rapid tax amortization and may also involve industrial dispersion, deconcentration, and special protective features.

The survey data would allow the Division to pre-plan raw material needs as well as initiate programs for the use of substitute materials to insure optimum plant output of essential commodities during an emergency.

Many capacity and end-use studies have already been completed and made available to industry and the public through publication in the Division's monthly Chemical and Rubber Industry Report. Surveys already published include the following:

benzene	acetylene	naphthalene
toluene	argon	anhydrous ammonia
sulfur	sodium bichromate	phosphorus and phosphoric acid
sulfuric acid	chlorates and perchlorates	methanol
calcium carbide	phthalic anhydride	formaldehyde

About 30 additional chemicals are currently scheduled for survey and should be completed in the near future.

Stockpiling Strategic Materials—As a result of the capacity and end-use surveys, or supply-requirement studies as they are often referred to, the Chemical and Rubber Division is able to determine the necessity for, and the extent of, stockpiling required in strategic commodities. Conversely, as supply and requirement features change, the Division recommends and aids in the disposal of stockpiled materials and equipment in relation to industrial needs so as to avoid any adverse effect on the national economy.

Administering the Defense Materials System—In addition to the planning of the vast and varied quantity of non-metallic materials necessary for the optimum operation of the chemical industry under emergency conditions, the Division preplans the small but essential amounts of steel, copper, and aluminum needed for operational purposes.

Mobilization Preparedness Activities—In this very important field of defense, the Division preplans "phantom" mobilization controls, involving such limitation orders, inventory controls, allocation and prohibition orders, as to least interfere with the proper flow of essential goods in a wartime economy. In addition, basic data are provided for use in the identification and rating of strategic facilities to be protected against the possibilities of enemy damage. Further, in close cooperation with industry, the Division participates in post-attack planning designed to coordinate and maintain industrial output and governmental continuity for meeting military and essential civilian needs.

In short, the chemical industry has a definite and material stake in the defense functions and activities of BDSA's Chemical and Rubber Division since the government and industry as partners will act together in distribution and inventory problems should M-day suddenly occur. All this can only be done by advance planning rather than by haphazard and heavy-handed application on the spur of the emergency moment. If you're forced to do battle, it's far better to be in training

[2] It might be well to point out that in recent years some segments of our Federal Government have been opposed to the rate of certifications granted for quick tax write-offs as well as to the size of the rapid tax amortization program itself. The criticism was that complete depreciation in five years left quite a hole in governmental revenues when these same facilities normally would be depreciated over a period of possibly twelve to twenty years. The amount of revenue "lost" to the U. S. Treasury has been estimated as high as $600 million during the peak years of rapid tax write-offs. However, while governmental revenue was reduced by substantial sums in this way during the 1951-54 period, the fact still remains that after the five year write-off, the company can claim no further depreciation on the certified facility and pays taxes fully thereafter in accordance with the corporate tax structure rates existing at that time. While Treasury budgeting and estimating may have been upset somewhat by the "tax am" program, the Government tax agency eventually gets its money and if the tax rate is subsequently higher, it gets more in the long run.
Some people have questioned whether a good part of the certified plants wouldn't have been built by industry anyway. The answer is that this would have occurred only to the extent judged sufficient by industry to meet growing civilian needs and certainly not enough to include the suddenly-expanded military requirements of Korean days.

for the fracas than to cast about for the proper weapons after the trouble has started, and industry's wholehearted cooperation in this respect proves the point well-taken.

Business Service Functions

At the time he established the Business and Defense Services Administration, Secretary Weeks announced that the business service activities of the industrial divisions of BDSA, in furtherance of economic stability and growth, would recommend policies designed to promote industrial expansion and business progress; analyze and disseminate information on the condition and levels of business activity in specific industries and trades pertinent to the production and marketing of industrial commodities; evaluate policies, plans, activities, and orders of the Department, as well as existing and proposed legislation; and assist domestic business in its relations with other departments and agencies.

All of these objectives have been accomplished by the Division and are maintained as continuing services. Among its business service duties, the Division:

1. Materially aids industry in the latter's relationships with other agencies of the government.
2. Provides pertinent information on chemical problems to Congressional Committees.
3. Maintains Industry Advisory Committees to which important problems are presented from time to time.
4. Furnishes interpretive data to industry in connection with various laws affecting chemicals.
5. Reviews proposed legislation in terms of possible effects on domestic and foreign legislation and makes pertinent recommendations to the Secretary of Commerce.
6. Helps formulate U. S. policy on world market problems and presents the views of the Department regarding specific industry or trade issues in foreign areas.
7. Reviews proposed changes in tariff rates with respect to their effect on domestic and foreign commerce and makes recommendations to the Secretary.
8. Assists in the development of new domestic and foreign markets, in the maintenance and expansion of existing markets, and in the acquisition of raw materials for domestic production.
9. Prepares production and distribution studies to serve as basic market aids and analytical tools for industry.
10. Is constantly answering technical queries from manufacturers, distributors, exporters, importers, consumers, Congress, state legislative officials, foreign governments and embassies, educational institutions, trade associations, and students.
11. Publishes monthly the Chemical and Rubber Industry Report which furnishes to industry and the public, in one central source, all statistical material of government agencies pertinent to chemicals and rubber. Besides showing basic industrial data, the Industry Report presents trends, outlook, and special articles on domestic and foreign production, sales, inventories, capital outlays, employment, and many other economic factors.[3]

Organization

The Chemical and Rubber Division is composed of the Director's Office and four branches. The Director is a WOC (without compensation) employee furnished by industry on a rotating basis every six months. This insures a changing and fresh industrial view and approach to current chemical problems besides establishing a corps of industrial experts subject to recall in an emergency. A better understanding of governmental procedures and methods is gained by industry in this way. Industrial policy decisions affecting individual companies are not acted upon by the Director but by the Deputy Director who maintains continuity of divisional efforts and programs.

Attached to the Director's Office are an Assistant Director for Rubber[4] who is responsible to the Director and his Deputy for rubber programs and policy; a Consultant on International Affairs whose functions include periodic appraisals of the chemical industry in specific foreign countries; a Programs Staff, which is responsible for integrating mobilization plans; and the Editor of the Industry Report responsible for its monthly issuance.

The four operating branches of the Division, the functions of which have been detailed in the foregoing, are as follows:

1. *Inorganic and Agricultural Chemicals Branch* with jurisdiction over such principal subgroups as: sulfur and sulfuric acid, chlorine and alkalis, halogen acids and related materials, industrial phosphatic chemicals, peroxygen compounds, chromium chemicals, sodium salts, compressed gases, fertilizer materials, pesticides, and miscellaneous inorganic chemicals.
2. *Organics and Drugs Branch* with jurisdiction over cyclic and acyclic organic chemicals such as dyes and toners, drugs and medicines, explosives, flotation agents, artificial flavors, rubber chemicals, plasticizers, chemicals for synthetic fibers and plastics, perfume materials, synthetic detergent chemicals, motor fuel additives, lubricating oil additives, and antifreeze chemicals. Other products for which this Branch is responsible include crude drugs, essential oils, vitamins, vitamin-mineral preparations, veterinary medicines, antibiotics, cosmetics, toilet preparations, charcoal, activated carbon, and aerosol chemicals.
3. *Plastics and Protective Coatings Branch* with jurisdiction over hundreds of plastics, protective coatings, and adhesives.
4. *Rubber Branch* with jurisdiction over natural, synthetic and reclaimed rubber and practically all rubber products.

Size of Industries Serviced

The chemical products industry with an annual sales volume of more than $23 billion and the rubber products industry with a volume over $5 billion cover many thousands of manufactured commodities and items. To a large extent, the U. S. Department of Commerce services these huge industries through BDSA's Chemical and Rubber Division.

[3] Annual subscription to the monthly Chemical and Rubber Industry Report is $1.50 domestic and $2.00 foreign.

[4] The rubber programs and problems of the Division, although similar in aspect, are not fully treated herein.

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Grasshopper fossil of the Jurassic Age, 140 million years ago
Photo courtesy American Museum of Natural History, New York

Here yesterday . . . here tomorrow?

In a very old Book, it is written: "The land is as the Garden of Eden before them, and behind them a desolate wilderness, yea, and nothing shall escape them." (Joel 2:3) The reference is to grasshopper damage. In the United States, grasshoppers inflicted heavy crop losses as early as 1797. In 1877, grasshoppers alone were causing 2 million dollars' damage to crops each year. In addition, many other kinds of crop pests were making serious inroads on all types of commercial and food crops. Growers were constantly faced with the spectre of near or total crop destruction.

Today . . . thanks to modern chemical discoveries . . . things are different! Pesticides such as aldrin, dieldrin, endrin, D-D(R), and Nemagon are powerful weapons in the "batttle of the bugs." They kill fast. In some uses, they kill for months and years after application. These pesticides were born of years of research and vast expenditures of money. But research never stands still! Even now, as these pesticides take their place as leaders throughout the agricultural industry, Shell Chemical has new pest-killing chemicals in the experimental stage. In time, they too will be ready for effective commercial application. And perhaps Mr. Grasshopper may indeed be "here today, gone tomorrow."

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SOME CONTRIBUTIONS TO THE GENERAL WELFARE FROM RESEARCH IN BIOLOGICAL WARFARE

By LEROY FOTHERGILL, M.D.
Chemical Corps
Fort Detrick, Frederick, Md.

THE DEPARTMENT of Defense spends a staggering sum of money each year for the research and development needed to create new instruments of war and, even more importantly, to assure the development of appropriate defensive equipment and procedures. One may have wondered from time to time about ancillary benefits that may have come from this military research. It may be pertinent to ask, "Is there something coming from this expenditure and scientific effort that will be of some value quite apart from the contribution to our national security? Will there be some by-product of value to the arts and sciences or that contributes to the general welfare?" It is reasonable to think that many items of military equipment, and the research and development that preceded their construction may have added little or nothing to our national wealth. For example, a battleship, per se, does not increase our national wealth; indeed, it continually consumes more of it in the form of fuel, manpower, etc. On the other hand, a freighter, an oil tanker or a passenger ship, are continually contributing to our national wealth. Nevertheless, the research that has gone into the construction of a modern battleship has provided much information that was useful in building, for example, a faster and safer passenger ship — in short, making a better piece of machinery for contributing to the national wealth.

Dr. Fothergill, born April 15, 1901 in Carson City, Nevada, was graduated from University of Nevada in 1924, and from Harvard Medical School with M.D. degree, cum laude, in 1929. He taught bacteriology and pediatrics at Harvard and was an Assistant Professor of Bacteriology and Immunology there when called to active duty in the Navy in 1941.

Dr. Fothergill organized the Department of Epidemiology at the Naval Medical School, Bethesda, Maryland, and directed it for approximately three years. From 1944 to 1946 he was stationed at Camp Detrick, serving as Technical Director of all research in BW during the last year of this period. He terminated his active military service in March 1945; holds the rank of Captain in the Medical Corps, U.S. Naval Reserve. In August 1946 he returned to Detrick to work as a civilian and is now Scientific Advisor to the Chief Chemical Officer for Biological Warfare at Fort Detrick. Dr. Fothergill has published many scientific papers and is a co-author with Zinsser and Enders of a textbook on Immunology.

One must hasten to point out that the expense incurred in the research to develop the various machines of war should not be regretted. Our national wealth is, in the last analysis, of no value whatever unless we can preserve and protect it.

With these considerations in mind, it is of interest to examine some of the by-products of the research in biological warfare at Fort Detrick. Such an analysis reveals that much of great value to the arts and sciences and the general welfare has come from this activity. This general thesis can be illustrated by describing a few of these contributions.

Weed Killers: During the War and subsequently, much fundamental information was developed at Fort Detrick concerning the basic activities and physiological properties of that new class of organic herbicide, represented by such compounds as 2,4-Dichlorophenoxyacetic acid (popularly known as 2,4-D), which are very important weed killers. The advent of these chemicals has completely revolutionized weed control practices. It would be difficult to assign a dollar value to this contribution to the general welfare.

Gaseous Disinfectant: The use of ethylene oxide as a gaseous disinfectant was investigated intensively at Fort Detrick. This compound was shown to have many unique properties for use in sterilizing sensitive materials. It is almost entirely non-corrosive and has great penetrating power. Delicate instruments, such as a chemical balance, and other materials which might be injured by sterilization by conventional methods can be sterilized by this gas when it is properly used. While it is an explosive under certain circumstances, it can be used safely when proper precautions are observed. Detailed information concerning the use of this gas has been made available in the scientific literature. Ethylene oxide is now being used as a sterilizing agent in many industrial practices.

Personnel Safety: The detailed analysis of various laboratory hazards and the development of procedures and equipment to assure safety for operating personnel must be listed as among the outstanding contributions of Fort Detrick. These studies, in fact, have been so productive, as to provide entirely new building criteria for laboratories and certain types of industrial production facilities. This information has been made available to potential users. Building criteria furnished by Fort Detrick

have guided the construction of many new laboratories throughout the country during the past few years in order to insure optimum safety. Newly developed types of safety equipment have been demonstrated at many scientific meetings.

Protection of Community: Fort Detrick has devised many unique safety procedures for the protection of the surrounding community. For example, all contaminated air coming from the laboratories is incinerated before being vented in the open and all sewage and other effluent from the laboratories is sterilized before being discharged at the sewage treatment plant. An amusing episode occurred in this connection during the War. Some of the Frederick City officials, who were concerned about activities at Detrick, tapped the sewer line as it then entered the city sewer and took samples for laboratory analysis. They were amazed and confounded to find that the sewage was sterile. The safety officer at Detrick would have been chagrined and upset if it wasn't sterile.

Rinderpest Vaccines: During the war a joint American-Canadian commission was established for the purpose of studying rinderpest of cattle—a devastating and rapidly spreading plague with a very high mortality. This malady has played a disastrous role in the economy of many countries, particularly in the Orient and in Africa. Fortunately, it has never been present on this continent. This commission established a laboratory for research on this disease on Grosse Ile — an isolated island in the St. Lawrence River which in days past had been used as a quarantine station for immigrants. This effort was, of course, dictated by a desire to provide additional protection for our cattle industry.

A rather crude vaccine for rinderpest had been developed in the Philippines prior to the War by the late Brigadier General Raymond Kelser who was chairman of this joint commission. This old vaccine was made by inactivating the virus-infected tissues of the host animal. Such a preparation was very expensive to prepare, even though it was effective. The selected tissues of one cow would provide only enough material to vaccinate about one hundred animals. This commission succeeded in adapting the virus of rinderpest to growth on the developing chick embryo. Eventually, the virus was attenuated for the host animal as a result of repeated passage through chick embryo tissue. This resulted in a cheap, easily produced vaccine that was extremely effective in protecting against the disease.

Shortly after the end of the War, this information was declassified and made available to all countries. Arrangements were made to furnish seed of the attenuated virus to those countries desiring it, together with information and instruction in the preparation of the vaccine. Needless to say, advantage was taken of this offer. It is impossible to estimate the value of this contribution. It is enormous.

The importance of this contribution can be illustrated by a particular episode which occurred immediately after the War. Some officials of UNRA approached General Kelser for his advice on certain problems in connection with rinderpest. This was natural since General Kelser was a recognized authority on this disease. UNRA was planning to spend several million dollars to build a laboratory in China and to finance the research necessary for the development of a new vaccine. These officials did not know, of course, that General Kelser was chairman of the joint American-Canadian commission that had been conducting the secret work on Grosse Ile. He could tell them nothing about it at the time. Fortunately, this information was declassified a short time later which then made it possible not only to provide UNRA with a technical solution for their problem, but to give them several million doses of vaccine for a start.

Vaccine for Anthrax: Anthrax, a disease of domestic animals of major economic importance, occasionally affects man, especially those exposed to certain occupational hazards such as in the wool and tanning industry. The only vaccine of reasonable value for use in animals, heretofore, has been a live spore vaccine — first developed, in fact, by Louis Pasteur. There has been considerable justifiable resistance to the use of this material. Since it consists of live, but presumably attenuated spores, its use is not without some danger. It cannot be used in man. During and after the War, scientists at Fort Detrick and their colleagues in England developed an entirely new anthrax vaccine. This is a soluble antigen containing no living material which can be produced by cultivation of the organism in a protein-free medium. It can be used safely in man. It is being used at the present time in employees of woolen mills in the Philadelphia area through a collaborative effort with the Pennsylvania State Health Department. There is every reason to believe that this will be a very effective vaccine which may eventually replace the Pasteurian type of product.

Study of Foot and Mouth Disease Facilitated: Fort Detrick made a significant contribution toward the control of another bovine malady; namely, foot and mouth disease. The Chemical Corps can take pride in the fact that its efforts were of great assistance to the Department of Agriculture in getting a laboratory on Plum Island for the purpose of studying this disease. During the past two years, this agency has conducted research in laboratories designed and constructed by the Chemical Corps. The new laboratories of the Department of Agriculture, under construction during this period of time, were formally dedicated by the Secretary of Agriculture on 26 September 1956.

This is the first time that a laboratory has been available in this country for studying this dreaded scourge of cattle; wherein proper and prompt diagnosis can be made and where prophylactic vaccines can be produced. Congressional law prohibits the introduction of the virus into laboratories on the mainland. The diagnosis of foot and mouth disease is not easy, especially when other vesicular diseases such as vesicular stomatitis are present. Diagnosis can only be confirmed, under these circumstances, by specific serologic and protective tests.

The production of a vaccine for this disease may be difficult because of the many different antigenic types of the causative virus. In some cases, a proper vaccine can be prepared only after the start of an epizootic, using the causative type of the virus for the purpose. This cannot be done, of course, without an adequate laboratory in being and a going concern at the time.

It must never be forgotten that foot and mouth disease is a constant threat. Outbreaks have occurred in both Canada and Mexico during the past few years — near our northern and southern borders, respectively.

Other Contributions: In addition to these and other specific items as by-products of research in biological warfare, much new knowledge of a more fundamental nature has been forthcoming from the Detrick laboratories. Much information has been developed concerning the treatment of certain infectious diseases. Our knowledge of the pathogenesis and control of respiratory diseases has been enriched by the research at Fort Detrick, using a variety of unique equipment developed especially for this purpose. Many studies have been made of microbiological genetics, adding significantly to knowledge in this complex field. These many contribu-

(Continued on page 16)

ARMED FORCES DAY PROGRAMS, MAY 18

MAJOR ARMY, Navy and Air Force commanders in the United States and overseas have begun planning for the eighth annual oboservance of Armed Forces Day, May 18, 1957. This year's observance marks 10 years of national military unification under the Armed Forces Act of 1947.

A joint command, to include Marine Corps and Coast Guard, has been established to coordinate all Armed Forces Day activities in each of seven geographical areas of the United States, with an area project officer or coordinator for each area. In addition, an Armed Forces Day project officer will be named at each Armed Forces post, camp, station, base or other command.

"Power for Peace" again will be the slogan of the day on which the public is invited to take a close look at the national defense system. Principal emphasis will be placed on the relationship between our national strength and our peaceful aspirations. A feature of the observance again will be "open house" programs and community projects at all installations, wherever feasible. Designed to give Americans and the peoples of friendly countries a better understanding of the personnel, equipment and teamwork of the various components of our Armed Forces, programs will feature educational exhibits, demonstrations, air shows, parades, drills, award ceremonies, vessels in port, meetings, sports events, social affairs, special films and similar activities.

General plans for the 1957 observance call for increased attention to the National Guard and other components of the Reserve Forces, Ground Observer Corps, Civil Air Patrol and similar supporting organizations.

Armed Forces Day Area Commanders:

AREA I (Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin, Wyoming); Commander: Lieutenant General William H. Arnold, CG, Fifth Army.

AREA II (Arkansas, Louisiana, New Mexico, Oklahoma, Texas); Commander: RADM John M. Higgins, Commandant, Eighth Naval District.

AREA III (Arizona, California, Idaho, Montana, Nevada, Oregon, Utah, Washington); Commander: RADM John R. Redman, Commandant, Twelfth Naval District.

AREA IV (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont); Commander: Major General Roger J. Brown, Commander First Air Force.

AREA V (Delaware, Kentucky, Maryland, Ohio, Pennsylvania, Virginia, West Virginia); Commander: Lieutenant General Charles E. Hart, CG, Second Army.

AREA VI (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee); Commander: Major General George G. Finch, Commander, Fourteenth Air Force.

AREA VII (District of Columbia and the neighboring areas of Maryland and Virginia within the Military District of Washington); Commander: Major General John G. Van Houten, Commanding General, MDW.

Overseas Commands

ALASKAN COMMAND: Lieutenant General Frank A. Armstrong, Jr., USAF, Commander-in-Chief.

CARIBBEAN COMMAND: Lieutenant General William K. Harrison, Jr., USA, Commander-in-Chief.

FAR EAST COMMAND: General Lyman L. Lemnitzer, USA, Commander-in-Chief.

PACIFIC COMMAND: Admiral Felix B. Stump, USN, Commander-in-Chief.

U. S. EUROPEAN COMMAND: General Lauris Norstad, USAF, Commander-in-Chief.

CONTRIBUTIONS FROM BW RESEARCH

(Continued from page 15)

tions to the arts and sciences and the general welfare can be emphasized by pointing out that over 850 scientific publications have been made by personnel of Fort Detrick during the past nine years. In addition, over 1100 papers have been presented before scientific meetings.

Aid in Science Training: Finally, one of the most outstanding by-products of the research at Fort Detrick has been the provision of ways and means for young men and women to get additional training in the several basic sciences. The laboratories at Detrick provide the opportunity for one of the best "internships" in this country for young scientists. Many different scientific disciplines are utilized. The facilities and the professional leadership are excellent and the opportunities are great. It has been possible, through individual arrangements with universities, for many young men and women to meet their thesis requirements for advanced degrees while actually pursuing the assigned mission for which they were employed. In addition to the work conducted in the local laboratories, a good deal of research is carried on by extramural contract which also assists young people in furthering their education. Since 1948, 42 individuals have earned their masters degrees and 50 persons have received their Ph.D. degrees as a by-product of their employment in the biological warfare program.

In conclusion, these ancillary benefits of research in biological warfare — only a few of which have been cited here — have contributed a great deal to the arts and sciences and the general welfare. While it is impossible to make an accurate dollar estimate of the value of this, it would be a reasonable and conservative presumption that it is greater than the total cost of the program.

REPORT ON DECONTAMINATING GERM-LADEN FOOD IN VANS

Critically needed foodstuffs contaminated by infectious organisms could be decontaminated in closed truck vans, scientists from the Army Chemical Corps Biological Warfare Laboratories, Fort Detrick, Frederick, Md., reported on December 4, 1956, at the semi-annual meeting of the Chemical Specialties Manufacturers Association, held in the Mayflower Hotel, Washington, D.C.

Dr. Benjamin Warshowsky, and co-authors, Bernard F. Surkiewicz, David R. Spiner of Detrick, and Saul Kaye, now with Ben Venue Laboratories, Bedford, Ohio, reported that three different chemicals might be used depending upon the type of food and the airtightness of the van.

The report was based on experiments conducted at Fort Detrick at the request of the Federal Food and Drug and the Civil Defense Administrations.

Formaldehyde, ethylene oxide and methyl bromide, all recognized gaseous decontaminants, were released into a standard 10-ton semi-trailer van and a refrigerated semi-trailer. These vans contained foods which had been contaminated with the spores of a harmless but hard-to-kill type of bacteria.

The best results were obtained by using ethylene oxide mixed with carbon dioxide in the relatively airtight refrigerated van. Formaldehyde worked best in the standard van and where it was necessary to sterilize only the surfaces of tightly packaged food. Formaldehyde will affect the taste of food, it was reported.

Methyl bromide is a sort of compromise. It is heavier than ethylene oxide but much more volatile than formaldehyde. In both vans, methyl bromide produced the second best results.

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CHEMICAL, BIOLOGICAL AND RADIOLOGICAL PROTECTIVE ASPECTS OF PERMANENT-TYPE SHELTERS

By WILLIAM E. GROSS
Chief, Protective Division
Products Engineering Directorate
Chemical Corps Engineering Command
Army Chemical Center, Maryland

THIS PAPER describes the consultation service afforded by the Chemical Corps regarding the chemical, biological, and radiological (CBR) protective aspects of air pressurized permanent-type shelters. No consideration is given to improvised structures which are air pressurized, or to the static, diffusion, or chemically revitalized air types of unventilated shelters.

Responsibility for Construction of Permanent-Type Shelters for the Department of the Army

The construction of permanent-type shelters for the Army is the responsibility of the Corps of Engineers and the basic design data are given in references (1, 2 and 3).[1] The following quotation from page 23, paragraph 2-16 of reference (1) serves as the basis for Chemical Corps participation, relative to the CBR protective aspects, in the engineering of permanent-type shelters: "Schematic diagrams should be prepared, indicating the size and arrangement of air filters and their relationship to air conditioning and other mechanical features proposed for the installation before proceeding. These diagrams should be submitted to the Office of the Chief of Engineers, along with requisitions for material that will be furnished by the Chemical Corps. This information will be forwarded to the Chief of the Chemical Corps, along with a request for comments and recommendations relative to the adequacy of the design." The Corps of Engineers also participates in the engineering of special shelters for emergency housing of essential civil government activities, and shelters for installation in public buildings which normally house essential civil governmental activities. In such construction, the relation of the Chemical Corps to the Corps of Engineers is normally the same as indicated for the Department of the Army shelters.

Responsibility for Construction of Permanent-Type Shelters for the Navy

Construction of permanent-type shelters for the Navy is the responsibility of the Bureau of Yards and Docks, which maintains CBR shelter engineering facilities essentially duplicate to those of the Chemical Corps. However, Chemical Corps collective protectors and accessory equipment are utilized. Testing of Navy shelters is performed by the Chemical Corps when requested.

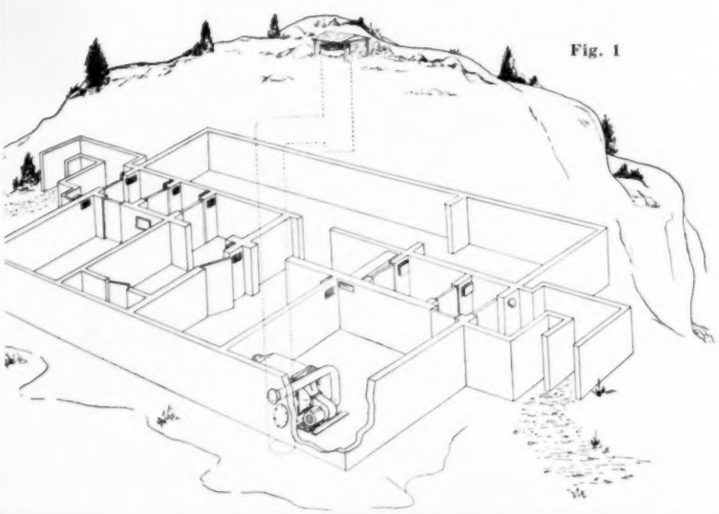


Fig. 1

Responsibility for Construction of Permanent-Type Shelters for the Air Force

Engineering of permanent-type shelters for the Air Force is done by the Air Force installation concerned unless the cost exceeds $25,000. For installations exceeding this amount the engineering is done by the Corps of Engineers. Consultation with the Chemical Corps relative to the CBR protective aspects may be by the Air Force or by the Corps of Engineers and is similar to that indicated above for the Department of the Army shelters.

Responsibility for Construction of Improvised Protective Shelters for Using Troops

Improvised shelters may be prepared by using troops operating in combat, communications, and interior zones. Such shelters may be prepared by conversion of existing structures. When field fortifications of the deliberate type are constructed, either by the Corps of Engineers or by using troops, the Corps of Engineers' design criteria are used. When these structures are built, action is generally taken to include the necessary features to make the structures resistant to entrance of CBR agents (4).

Responsibility within the Chemical Corps for Provision of CBR Protective Shelter Consultation Service

The Chemical Corps provides CBR protective shelter consultation service through the Chemical Corps Engineering Command, Army Chemical Center, Maryland. The Chemical Corps Chemical Warfare Laboratories, Army Chemical Center, Maryland and the Chemical Corps Biological Laboratories, Fort Detrick, Maryland, provide the Engineering Command with technical assistance and testing facilities relative to their activities as required.

Desirability of Consulting Chemical Corps during Early Planning Stages of Shelters

In the case of new-shelter construction, it is very desirable, in the interest of economy, that the Chemical Corps be consulted relative to the CBR protective aspects when designs are in the very early planning stages. This is necessary because of the interrelation of the protective equipment to the utilities and protective closures which must be provided as basic equipment of the shelter. This interrelation often introduces numerous engigineering problems which should be solved in the planning stages.

[1] Numbers in parentheses refer to the bibliography at the end of the paper.

Various Uses for CBR Protective Shelters

While permanent-type CBR shelters are utilized for various purposes, some of the more common uses are for housing military and civil government operational headquarters and civilian defense activities.

General Design Considerations

General design considerations relative to the CBR protective aspects of protective shelters include, as indicated in reference (1):

a. Design factors, such as occupant allowances, ventilation, ingress and egress means, personnel decontamination, power and heating plants;

b. Protection afforded as affected by traffic and air sanitation;

c. Sites for structures as affected by air drainage, air currents, vegetation;

d. Construction materials, such as finishes, caulking and leak-proofing compounds and painting and insulation;

e. Physiological principles relative to the effect of temperature, humidity, carbon dioxide and oxygen;

f. Entrance features, such as general door construction, outer air lock doors, inner air lock doors, exterior doors, wood doors, seals, door hardware, and fenestration;

g. Air lock requirements and design features, such as air lock chamber sizes, single locks, double-lock construction, and stretcher lock air-regulating devices.

Basic Design of CBR Protective Shelters

The design and complexity of CBR protective shelters varies greatly depending upon numerous factors, such as intended use, whether the structure is designed for the specific use or is a converted available structure. A basic shelter consists generally of a blast-, missile-, moisture- and air-permeation-resistant structure containing a room or rooms for housing the activity which it is desired to protect, a double air lock for ingress of contaminated personnel, a double air lock for egress, means for disposal of contaminated clothing and adequate decontamination of personnel and sanitary facilities. The shelter is air pressurized by means of a mechanically driven Chemical Corps collective protector, described below.

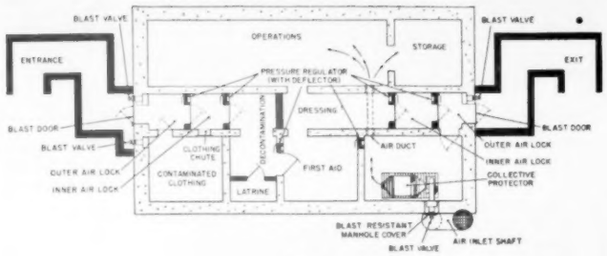


Fig. 2

Normally, the highest pressure used is approximately 0.5 to 0.6 inch of water, depending on the number of air locks. The highest pressure is maintained in the shelter proper, with the pressure approximately 0.1 inch lower in each succeeding air lock starting from the main shelter, and the lowest pressure in the outer lock. This pressure graduation is necessary to prevent contaminated air from flowing into the main shelter when the locks are being used. The normal path for exhaust of excess air is from the shelter proper out through the air locks which, by this action, are scavenged of contaminated air brought in by entering personnel.

Depending on the type of shelter, an auxiliary power supply may also be required. Details of CBR shelter construction are given in the pertinent references of the bibliography. A shelter of simple design is illustrated schematically in Figures 1 and 2. In the schematic diagrams no attempt has been made to portray types of approved construction details such as nuclear blast resistant personnel entrance closures, etc., which are handled entirely by the Corps of Engineers.

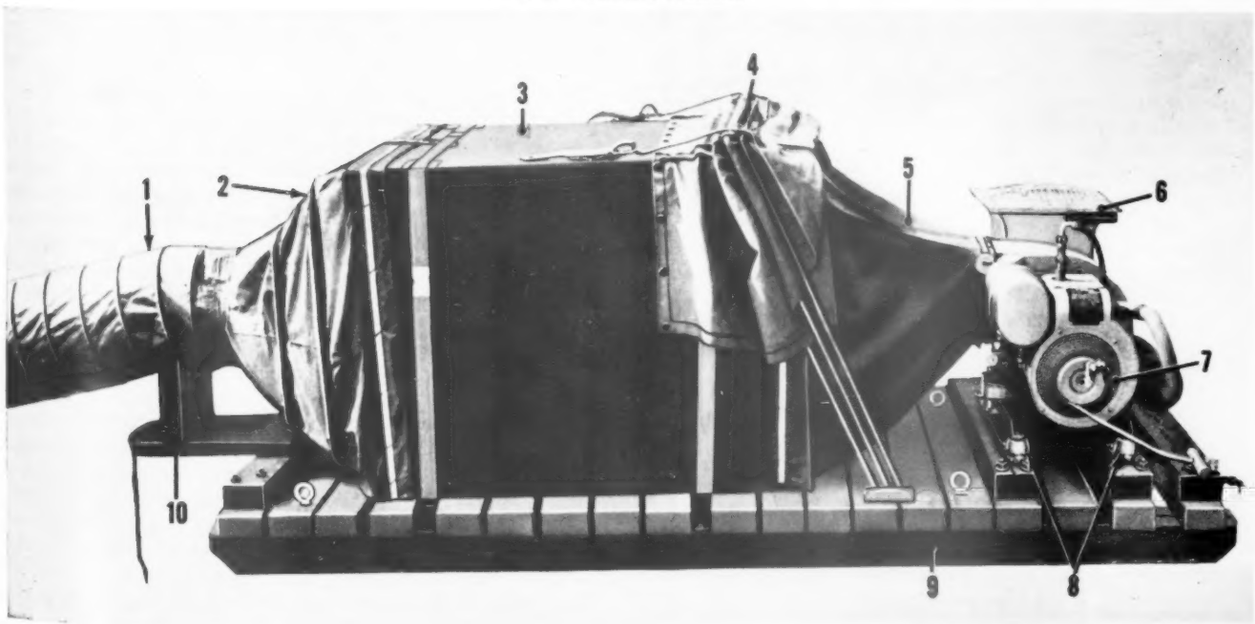
Also in the type structure shown, the blower is normally installed effluent to the gas and particulate filter to ensure a negative pressure in the ducts carrying contaminated air. This avoids contamination of the protector room in the event of duct leakage.

Equipment Required for Ensuring CBR Protection of Permanent-Type Shelters

The CBR protective equipment for shelters consists primarily of a collective protector which is a specialized

(Continued on page 28)

Fig. 3. Collective Protector



THE AMERICAN CHEMICAL SOCIETY AND THE CHEMICAL CORPS

Dr. Murphy, editorial director of four publications of the American Chemical Society, including its weekly magazine, CHEMICAL AND ENGINEERING NEWS, is widely known in the chemical world and occupies an outstanding position in the field of chemical journalism. He has for some years been one of the Directors-at-Large of the Armed Forces Chemical Association and is a consultant to the Army Chemical Corps. While he needs no introduction to Journal readers, it is pertinent to record here some of the milestones in his career.

Dr. Murphy was born in Brooklyn, N. Y., August 20, 1899, and was graduated from the Polytechnic Institute there in 1921 with a BS degree in chemistry. His first professional position was with Air Reduction Company as a research engineer working on the purification and industrial application of rare gases, principally neon. Later he joined the American Cyanamid Company as sales engineer. He travelled extensively in Latin-American countries. In 1923, by invitation of the Puerto Rican Insular Government, he worked out with their agricultural authorities details for large-scale fumigation of tobacco warehouses.

In 1930 Dr. Murphy entered chemical journalism as managing editor of "Chemical Markets." In 1942 he was selected by the American Chemical Society as successor to the late Harrison E. Howe in four of the Society's editorial posts.

In 1945 he went to Europe as the representative of the Technical Industrial Intelligence Committee of the Joint Chiefs of Staff, and investigated wartime developments in the German chemical industry.

In 1946 he was a technical representative at the Bikini Atom Bomb test in the Pacific.

In 1947 an honorary degree of Doctor of Science was awarded Dr. Murphy by Centre College of Kentucky. He is a Fellow of the American Association for the Advancement of Science, a member of the Washington and New York Academies of Science, a member of the Advisory Council for Science and Technology of Notre Dame University and of the Advisory Board for Research of Fordham University.

Dr. Murphy is co-author of "Strategic Materials for Hemisphere Defense," author of "I Did Leave Home," a book on the investigation of the German chemical industry, and has written numerous magazine articles. He is also widely known as a lecturer on chemical and other scientific matters.

By WALTER J. MURPHY

IT IS NO mere coincidence that the colors of the American Chemical Society and the Chemical Corps are the same—blue and gold. The Chemical Warfare Service, predecessor of the Chemical Corps, adopted the ACS colors as a tribute to the services that many American Chemical Society members performed in the formative period of CWS in World War I.

In reviewing issues of INDUSTRIAL AND ENGINEERING CHEMISTRY, now nearly 40 years old, it is difficult to determine what, if any, official actions the Society took in helping to create CWS. We gain the impression that the steps taken were unofficial and largely at the initiative of certain outstanding leaders of chemistry of that day, particularly Charles Lathrop Parsons, then Secretary of the Society.

When Parsons became Secretary in 1907, he was professor of chemical engineering at the University of New Hampshire. In 1912, he moved to Washington and was appointed chief chemist of the Bureau of Mines, still retaining, of course, his position as secretary of the Society. This dual role made it possible for him to exert tremendous influence in and out of government circles, and in many diverse ways to catalyze cooperation between the ACS and many government agencies.

In the fall of 1916, Parsons as chief chemist of the Bureau of Mines and as agent of the War Department, visited the leading munition plants of England, France, Italy, Norway, and Sweden. Quite naturally his contacts were with high officials. As a result of this visit he obtained much firsthand knowledge of the application of chemistry to war conditions. This was particularly true in the fields of nitrogen fixation and gas warfare. He realized, perhaps more than any other person in Washington, the vital role of the chemist and the chemical engineer in providing the sinews of war. Not infrequently World War I was referred to as "a chemist's war." Parsons, as a result of his observations in Europe and knowing the limitations of the pre-World War I American chemical industry, particularly in the production of organic chemicals, sensed that America had insufficient numbers of chemists and chemical engineers to cope with a major emergency.

Immediately upon his return to the United States, he interested the director of the Bureau of Mines in a plan of making a census of American chemists and chemical engineers, in order that each available man might serve his country where he could do the greatest good. He wanted to make certain that the relatively few chemists and engineers we did have were used where they could make the maximum contribution, in the event America was forced into the conflict.

THIS CENSUS was conducted under the joint sponsorship of the Bureau of Mines and the American Chemical Society. It was a most fortunate step, because within a matter of months the United States did enter the War, and the dire need for more chemists and chemical engineers in essential war work became immediately apparent. A greater mobilization of our manufacturing resources took place, it became necessary to return chemists from the front lines in France to do research and direct production.

One very obvious area was in the field of gas warfare

research. The use of chlorine by the Germans at Ypres on April 22, 1915 shocked the world and came within a fraction of an inch of defeating the Allies. Chemists in the allied countries concentrated their attention at first upon the protection against the military use of toxic gases. Later, research was extended in an effort to discover other gases more effective than chlorine. Ultimately several were developed. The ability of the Allies to retaliate and to provide satisfactory protective equipment unquestionably had a deterring effect on the Germans.

Research on gas warfare in the United States was first begun by the Bureau of Mines at an experiment station on the campus of American University in Washington. An Advisory Committee consisted of the following members of the American Chemical Society: W. H. Nichols, chairman, E. C. Franklin, W. Hoskins, C. L. Parsons, I. Remsen, T. W. Richards, H. P. Talbot, and F. P. Venable. Those who are at all familiar with the history of the ACS will recognize that this committee was staffed by top-flight members of the chemical profession. Five of them served as president of the Society: W. H. Nichols, E. C. Franklin, I. Remsen, T. W. Richards and F. P. Venable.

It is not difficult to picture the role Parsons played first in interesting the Bureau of Mines in gas warfare research, and then in helping to direct it in its early stages. He loved to operate behind the scenes, yet no man in the profession was more direct in his dealings with others.

Ultimately the experiment station for gas warfare research was transferred from the Bureau of Mines to the War Department, under an Executive Order of President Wilson, dated June 25, 1918. Three days later another Executive Order authorized the U. S. Army to organize a Chemical Warfare Service.

This move was not a popular one with most chemists. There was real fear of the military dominating the research program. However, a substantial number of chemists were commissioned in CWS, and the transfer was thereby made more acceptable to the chemical profession.

In the list of colonels, lieutenant colonels and majors are the names of many men who have subsequently held high office in the American Chemical Society. Parsons was offered a colonelcy but rejected it, believing that his work could be much more effective if he remained a civilian and continued as secretary of the ACS.

The chemical profession can be very proud of the accomplishments of those who served in CWS during World War I. Without them, it is unlikely the Allies would have achieved victory.

WE CANNOT in the space allotted review, in detail, the long history of cooperation between the American Chemical Society and the Chemical Warfare Service, now known as the Chemical Corps. Between World War I and World War II, the Society had a committee which served in an advisory capacity. In most of this period its chairman was Harrison E. Howe. At times, this committee was quite active. Sometimes it met only at infrequent intervals. However, in the same period prominent members of the Society acting individually, served as consultants and rendered valuable services—especially at a time when CWS seemed to be "a forgotten" element in the military setup of the nation.

One may question whether Parsons was the chief early architect of CWS. However, it was his farsightedness which led to the preliminary work in gas warfare undertaken by the Bureau of Mines. When the time came for transfer of this research program to the War Department, he saw to it that many leading chemists were commissioned.

Perhaps Parsons' attitude toward CWS was paternalistic. If it was, such feeling is understandable. Nevertheless, his close relationships with it did not deter him from criticizing severely the drafting in World War II of civilian scientists employed at Edgewood, and other installations operated by the Chemical Warfare Service. He felt strongly that CWS should have exerted more pressure to hold these men at the research bench. Ultimately this controversy led the Board of Directors to discharge its Committee Advisory to the Chemical Warfare Service.

In the postwar years very cordial relations have been re-established between the Society and the Chemical Corps. The ACS Committee Advisory to the Chemical Corps is now and for a number of years has been one of the most active committees in the Society framework. First under the chairmanship of H. J. Johnstone of the University of Illinois, and more recently under C. C. Price of the University of Pennsylvania, the committee has functioned in a number of fields important to the continuing progress of the work of the Chemical Corps. Subcommittees are active in the following fields: public relations, research, industrial relations, and education.

The Advisory Committee working through the Public Relations Subcommittee, has endeavored to tell the story of the Chemical Corps to the chemists and chemical engineers of this country. The Subcommittee on Public Relations has concerned itself with such areas as the declassification of certain types of information of value to industry. Similarly, it has stimulated the release of information of interest to the general public, thereby helping to improve public attitudes toward the Corps. Occasionally it has helped dispel misunderstanding on the part of enlisted personnel on such matters as the operation of the Enlisted Scientific and Professional Personnel Program.

The Industrial Relations Subcommittee emphasizes the importance of continuing liaison between the Corps, industrial organizations, and research laboratories. The Subcommittee on Research evaluates on a continuing basis nonresident research. The Educational Subcommittee aids in the recruitment of scientific talent, and endeavors to devise ways and means of keeping competent personnel already employed.

The main committee and subcommittees meet at frequent intervals. Meetings are usually scheduled at each of the national meetings of the Society. In addition, special meetings are held from time to time, at Edgewood, Camp Detrick, and other Chemical Corps installations. The Board of Directors of the American Chemical Society has been briefed on a number of occasions on the work of the Corps.

ONE OF THE great difficulties facing the Chemical Corps is that of educating the American public to a proper understanding of its work and responsibilities. The "horror" poison gas stories of the early twenties published in Sunday newspaper supplements and national magazines, depicting entire populations of large cities killed by gas, created an unfavorable atmosphere that is difficult to dispel. Most unfortunately, the passage of 30 years does not appear to have lessened the feeling on the part of the public that use of poison gas somehow is much more diabolical than other forms of offensive weapons. Are CBR weapons more so than an A or an H-bomb? For some unknown reason the public seems to think they are.

In an editorial published in CHEMICAL AND ENGINEERING NEWS under the title, "A Startling Contrast" (Aug. 17, 1953), it was pointed out that the public has adopted a philosophical viewpoint on A-bombs, even

(Continued on page 23)

GROUP AND SUSTAINING MEMBERS

OF THE ARMED FORCES CHEMICAL ASSOCIATION

Abbott Laboratories, North Chicago, Ill.
Adache Engineers, Cleveland, Ohio
Air Reduction Company, Inc., New York, N.Y.
Allied Chemical & Dye Corporation, New York, N.Y.
American Cyanamid Company, New York, N.Y.
American Zinc, Lead & Smelting Co., St. Louis, Mo.
Armour & Company, Chicago, Ill.
Armstrong Cork Company, Lancaster, Pa.
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Borden Company, The, Philadelphia, Pa.
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THE AMERICAN CHEMICAL SOCIETY

(Continued from page 21)

H-bombs. It seems to recognize and accept the fact that atom bombs are a *fait accompli* and that the clock cannot be turned back. It has resigned itself to living with the thought that such lethal weapons may be used. Perhaps of still greater significance, however, is the rationalization by the public that much good has come from the discovery of the secret of splitting the atom, and it believes firmly, more is on the way. Therefore, it has come to more or less accept the bad and the good.

The chief reason the AEC enjoys in the main a favorable press is that it has done an excellent job of convincing John Q. Public that it is helping researchers to make life better and longer for most of us, provided, of course, we do not find ourselves involved in World War III.

The Chemical Corps, too, has made and will continue to make notable contributions in research of special significance to our health and general welfare. But this message has not been brought home to the man on the street in a convincing manner. He has no concept whatsoever of the size and scope of the research program of the Chemical Corps. What he is entirely ignorant of, he fears.

The place to begin this public relations educational program is with the members of the chemical profession. They are in a unique position to help inform the public once they have been adequately informed. The Advisory Committee of the ACS to the Chemical Corps considers this one of its primary objectives. It hopes to obtain effective assistance from the 150 local sections of the Society. There is at least one now in every state of the Union, in Hawaii, and Puerto Rico. The more than 78,000 members of the ACS can be first-line ambassadors for the Corps.

* * *

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THE PHARMACOLOGY OF NERVE GAS POISONING

By J. H. WILLS and R. V. BROWN

Pharmacology Branch
Directorate of Medical Research
Chemical Warfare Laboratories
Army Chemical Center, Md.

Foreword

Drs. Wills and Brown are, respectively, the Chief and Deputy Chief of the Pharmacology Branch in the Directorate of Medical Research at the Chemical Warfare Laboratories. The Pharmacology Branch has been concerned with studies of the treatment of experimental nerve gas poisoning. Recently, their work has dealt with oximes related to the hydroxamic acids discussed by Dr. William H. Summerson in the article published in this Journal in January 1955: "Progress in the Biochemical Treatment of Nerve Gas Poisoning." Drs. Wills and Brown have prepared the present article to survey the entire field of drugs known to be of value in the treatment of nerve gas poisoning and to show the place of the oximes in this particular field.

NERVE GAS poisoning arises, of course, by the entrance into the body of one of the nerve gases: tabun (ethyl N,N-dimethyl phosporamidocyanidate), sarin (methyl isopropyl phosphonofluoridate), soman (methyl pinacolyl phosphonofluoridate) or functionally similar phosphorous derivatives. All of the nerve gases resemble the well-known compound DFP in being able to inhibit *in vitro* and *in vivo* the activity of the enzyme cholinesterase. This action is regarded generally as being the principal explanation for the toxic actions of the nerve gases, the inhibition of cholinesterase allowing local and general concentrations of acetylcholine to rise to values which induce overactivity, and finally in many cases complete cessation of activity, in many structures of the body. To understand nerve gas poisoning, it is necessary, therefore, to know something first about the functional effects of acetylcholine.

The first living source from which acetylcholine was isolated is ergot, where it was found by Ewins in 1914. The compound had been prepared chemically by Baeyer in 1867, and had been found by Hunt and Taveau in 1906 to have powerful but fleeting effects in the body. Acetylcholine is split in watery solutions, but at much too slow a rate to explain the brief duration of its action in the body. We know now that blood and body tissues contain enzymes which are capable of accelerating markedly the rate of hydrolysis of acetylcholine. One of these enzymes is quite specific in its ability to split acetylcholine and very few other compounds; it is called, therefore, true cholinesterase or acetylcholinesterase. Another enzyme, or perhaps group of enzymes, is able to split a wide variety of choline esters and is called pseudo cholinesterase. A third enzyme, or group of enzymes, has the ability to hydrolyze esters in general and includes acetylcholine among the substrates which it will affect. This enzyme is called ali-esterase. In general, ali-esterase is not concerned in the phenomenology of acute nerve gas poisoning. Indeed, many think that pseudo cholinesterase also plays no part in the removal of acetylcholine and that acetylcholinesterase, which is present generally in nervous tissues and in skeletal muscle and red blood cells, is the only one of this group of enzymes to have any significant role in acetylcholine hydrolysis *in vivo*.

Acetylcholine was isolated and identified chemically and functionally as a constituent of animal tissue by Dale and Dudley in 1929, using horse spleen. There is now presumptive evidence that acetylcholine is released at many nerve terminations in the body whenever a nerve impulse passes down the nerve fiber. This acetylcholine is believed to diffuse across the very small space separating the nerve termination and the structure innervated (a muscle fiber, for example) and to unite with a receptor protein in the surface of the latter. It is this union which is thought to initiate the activity characteristic of the particular structure innervated. The functional importance of acetylcholinesterase is that it appears in tissues in approximately the same places as the receptor protein, and that it limits the existence of acetylcholine in union with the receptor protein by hydrolyzing the acetylcholine. Inactivation of acetylcholinesterase by nerve gas allows the acetylcholine to remain united with the receptor protein for much longer periods of time and to be present in the vicinity of the receptor protein in much higher concentrations than are usual.

The functional effects of acetylcholine, whether produced within the body or introduced into the body, are the same and are divided usually into three categories of actions: a. Choline-like actions, including constriction of the pupil, stimulation of secretion by the glands of the respiratory and gastrointestinal tracts, stimulation of the smooth muscles of the respiratory, gastrointestinal and genito-urinary tracts, slowing of the heart and stimulation of sweat glands; b. Nicotine-like actions, including stimulation followed by depression of activity of skeletal muscles, ganglia and adrenal glands; c. Central neuronal effects, consisting of facilitation followed by inhibition of synaptic transmission within the central nervous system. In general, the nerve gases lead to these same functional changes. There is some variation in the pattern of effects produced by different compounds, but the effects themselves are very similar.

On the basis of the idea that both receptor protein and cholinesterase are involved in the genesis of the discrete effects making up the syndrome of nerve gas poisoning, there are the following general possibilities for chemically protecting functional organs against nerve gas poisoning:

a. Prophylaxis, where the protective drug can be administered before the nerve gas reaches the body:

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2. Block access of acetylcholine to the receptor protein.
3. Destroy the nerve gas before it can impinge upon cholinesterase in important sites.

b. Therapy, where the protective drug must be used after nerve gas has reacted with cholinesterase in important sites and acetylcholine has accumulated in the vicinity of the receptor protein:

1. Block access of acetylcholine to the receptor protein.
2. Regenerate cholinesterase activity.

Possibility a-1 can be achieved by using compounds which react with cholinesterase themselves, but which differ from the nerve gases in reacting reversibly with the enzyme. Two general classes of drugs satisfy these requirements: reversible cholinesterase inhibitors (like physostigmine) and local anesthetics (procaine, for example). Members of these two classes of compounds have quite significant prophylactic activity; the reversible cholinesterase inhibitors have no therapeutic value, and in fact increase the severity of nerve gas poisoning if given after the nerve gas, but the local anesthetics do have some therapeutic activity. Both the reversible anticholinesterase compounds and the local anesthetics can be used safely only with careful and close observation. They are not suitable for use by untrained individuals.

Possibilities a-2 and b-1 involve the same considerations and may be discussed together. The same compounds which prevent the access of acetylcholine to the receptor protein in cholinophilic functional systems are effective also in central neuronal structures, so long as the compounds are not quaternary amines. Quaternary amines penetrate the barrier between the circulating blood and the central nervous system very poorly. On the other hand, the quaternary amines may be active in nicotinophilic functional systems as well as in cholinophilic ones. In general, tertiary amines have little, or no, effect on the functional structures of nicotinophilic systems.

Atropine is the classical drug for preventing access of acetylcholine to the receptor protein in the structures yielding responses evokable by choline. The finding that atropine is effective against the choline-like and the central neuronal actions of the nerve gases has led to the screening of a large number of anticholinergic drugs for ability to prevent mortality from a standard poisoning with sarin. No anticholinergic compound has been found which seemed both sufficiently effective and sufficiently innocuous to warrant its recommendation as a replacement for atropine in the prevention or treatment of nerve gas poisoning. Atropine is a very safe drug from the standpoint of fatality production, but is intoxicating.

From the screening studies it is apparent that esters of the general structure $CH(R,R_1)C(O)OC_2H_4N(R_2)_2$, where R and R_1 are comparatively large groups and R_2 is comparatively small, are more effective and less lethal than the corresponding amides, ethers and compounds with other types of linkages. Double-ended derivatives of ethylene diamine are over 3 times as lethal and only ¼ as active as the esters. Phenothiazine derivatives corresponding to the ethylene diamine derivatives so far as the free amine group is concerned are ⅓ as lethal and over 5 times as active. These phenothiazine compounds compare favorably with the ester-linked compounds with which the comparison started. Ester-linked phenothiazine derivatives are more active than the straight carbon chain compounds but are also several times more lethal, so that introduction of the ester linkage has conferred no overall advantage upon this type of compound.

Within the group of esters of the general structure given above, the diethyl amino compounds have a more favorable ratio between efficacy and lethality than dimethyl amino or pyridino compounds. Branching of the ethylene chain lowers efficacy more than it lowers lethality. A desirable alteration of structure within the ester-linked type of compound is hydroxyl substitution on the alpha carbon of the acid moiety, which leads to a greater increase in efficacy than in lethality. Increase in the molecular weight of the acid moiety leads to a progressive increase in potency up to a maximum at a radical weight of about 227; lethality passes through its maximum at a radical weight of about 210.

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Because artificial respiration of mass casualties from nerve gas would require a large number of operators, some chemical means for overcoming the neuromuscular block has been sought. N-methyl and N-isopropyl atropinuim compounds were found to have brief actions in overcoming the block to single stimuli. Atropine quaternized with benzyl or phenacyl groups and certain bis (alkane ammonium) oxamide compounds are capable of reversing permanently nerve-gas-induced block of responsiveness of a skeletal muscle to slow electrical stimulation of its motor nerve. In general, however, these compounds do not restore the ability of the muscle to respond to a volley of nerve impulses. The atropinium compounds do have some effect in this direction. A much more rapid and striking change is accomplished by 2-PAM (2-formyloxime N-methyl pyridinium iodide). Intravenous injection of 2-PAM into cats poisoned with either tabun or sarin produces rapid and complete recovery of the ability to maintain a sustained contraction. Intravenous injection of 2-PAM along with atropine into rabbits poisoned previously with nerve gas gives a much more effective therapy than either the 2-PAM alone or the atropine alone. The effectiveness of 2-PAM in overcoming neuromuscular block may be the principal reason for its success as an adjunct to atropine in treating nerve gas poisoning.

Because ganglia are among the structures brought into abnormal activity by the nicotine-like actions of nerve gases, another obvious direction in which to look for adjuncts to atropine in protecting against nerve gas poisoning is among compounds having the ability to block ganglionic transmission. Of particular potency in this regard are the bis-quaternary diamines of moderate chain length. Study of a series of such compounds for adjunctive activity in treatment of nerve gas poisoning has shown that the optimal chain length between the two quaternary heads is 5 carbon atoms. Alteration of the composition of the chain with maintenance of approximately the same chain length, as by the introduction of an oxygen, a sulfur or a nitrogen atom into the chain, reduces efficacy, the introduction of an oxygen atom having the most marked effect. Changes in the constitution of the quaternary head also vary the adjunctive efficacy. The pentamethylene derivative with triethyl ammonium heads is more effective than the one with trimethyl ammonium heads or than the compound with dimethyl ethyl ammonium heads. The bis (triethyl ammonium) pentamethylene iodide used along with atropine in the therapy of nerve gas poisoning in experimental animals is not quite so effective an adjunct as 2-PAM but is still significantly adjunctive.

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The anticholinergic drugs, like atropine, have very little effect on the nicotine-like effects which arise from ganglia and skeletal muscles. The most important of these nicotine-like effects is paralysis arising from failure of transmission across the neuromuscular junction; this results in inability of the poisoned individual to breathe or to use his arms and legs. The failure of respiration must be overcome quickly if the man is to continue living. One way of accomplishing this is to administer artificial respiration by some method which produces significant ventilation of the respiratory system. Atropine plays an important role in promoting artificial ventilation because it stops secretion by the glands of the upper respiratory tract and of the mouth, so that fluid no longer tends to accumulate above the voice box. Before satisfactory ventilation of a poisoned individual can be achieved, even though the man may have received adequate doses of atropine, the fluids in the mouth and throat above the voice box must be removed carefully to permit free passage of air into and out of the lungs.

Because artificial respiration of mass casualties from nerve gas would require a large number of operators, some chemical means for overcoming the neuromuscular block has been sought. N-methyl and N-isopropyl atropinuim compounds were found to have brief actions in overcoming the block to single stimuli. Atropine quaternized with benzyl or phenacyl groups and certain bis (alkane ammonium) oxamide compounds are capable of reversing permanently nerve-gas-induced block of responsiveness of a skeletal muscle to slow electrical stimulation of its motor nerve. In general, however, these compounds do not restore the ability of the muscle to respond to a volley of nerve impulses. The atropinium compounds do have some effect in this direction. A much more rapid and striking change is accomplished by 2-PAM (2-formyloxime N-methyl pyridinium iodide). Intravenous injection of 2-PAM into cats poisoned with either tabun or sarin produces rapid and complete recovery of the ability to maintain a sustained contraction. Intravenous injection of 2-PAM along with atropine into rabbits poisoned previously with nerve gas gives a much more effective therapy than either the 2-PAM alone or the atropine alone. The effectiveness of 2-PAM in overcoming neuromuscular block may be the principal reason for its success as an adjunct to atropine in treating nerve gas poisoning.

Because ganglia are among the structures brought into abnormal activity by the nicotine-like actions of nerve gases, another obvious direction in which to look for adjuncts to atropine in protecting against nerve gas poisoning is among compounds having the ability to block ganglionic transmission. Of particular potency in this regard are the bis-quaternary diamines of moderate chain length. Study of a series of such compounds for adjunctive activity in treatment of nerve gas poisoning has shown that the optimal chain length between the two quaternary heads is 5 carbon atoms. Alteration of the composition of the chain with maintenance of approximately the same chain length, as by the introduction of an oxygen, a sulfur or a nitrogen atom into the chain, reduces efficacy, the introduction of an oxygen atom having the most marked effect. Changes in the constitution of the quaternary head also vary the adjunctive efficacy. The pentamethylene derivative with triethyl ammonium heads is more effective than the one with trimethyl ammonium heads or than the compound with dimethyl ethyl ammonium heads. The bis (triethyl ammonium) pentamethylene iodide used along with atropine in the therapy of nerve gas poisoning in experimental animals is not quite so effective an adjunct as 2-PAM but is still significantly adjunctive.

(Continued on page 37)

RESUSCITATOR DESIGNED TO AID VICTIMS OF NERVE GAS ATTACKS

Army announces development by Chemical Corps and Medical Department of device utilizing gas masks to facilitate giving of artificial respiration treatment.

Members of the 9710 TU, Army Chemical Center, Edgewood, Maryland, demonstrate the new resuscitator designed at the arsenal.

An artificial respiration device which aid men can use to treat nerve-gas casualties *during a gas attack* is being developed by the Army Chemical Corps in collaboration with the Surgeon General of the Army for use by the medical services.

The device, states the recent announcement by the Department of the Army, can also be used to give artificial respiration in drowning cases, electrical shock, suffocation and similar accidents. The resuscitators will not be generally available for at least a year.

This is the first device, according to the announcement, that would permit artificial respiration in contaminated air. Labeled the mask-to-mask resuscitator, it utilizes the power developed by the aid man's breathing to supply purified air to the casualty's lungs even though treatment is being given in a toxic atmosphere.

Experiments have shown that the mask-to-mask resuscitator outperforms any manual form of artificial respiration.

The tests have demonstrated that by substituting a mouthpiece for the mask and removing the canister, the resuscitator is readily adaptable to civilian uses in normal atmospheric conditions where artificial respiration is necessary.

The resuscitator consists of two hose assemblies joined by a rubber connector to an anesthetist-type oronasal mask, a modified standard Army field protective mask connected to the end of one hose assembly, and a standard gas mask canister connected to the end of the other hose assembly. The operator inhales purified air through the canister and causes the hose to fill with purified air at the same time. When the operator exhales he forces the purified air from the hose into the patient's lungs through the oronasal mask which is pressed firmly against the patient's face. While the operator is inhaling again, the patient's exhaled air is allowed to escape through a valve. The cycle then may be repeated indefinitely.

The device also provides a more versatile and sensitive method of artificial respiration since any obstruction of the patient's airway would be felt immediately by the operator in the form of increased breathing resistance. This is overcome by elevating the casualty's jaw, by heavier breathing, or by mechanically clearing the airway.

Experimentation also demonstrates that it would be possible to give artificial respiration to a casualty while he is being carried on a stretcher—an impossibility now—through the use of a tube connecting the trachea with the mask-to-mask resuscitator.

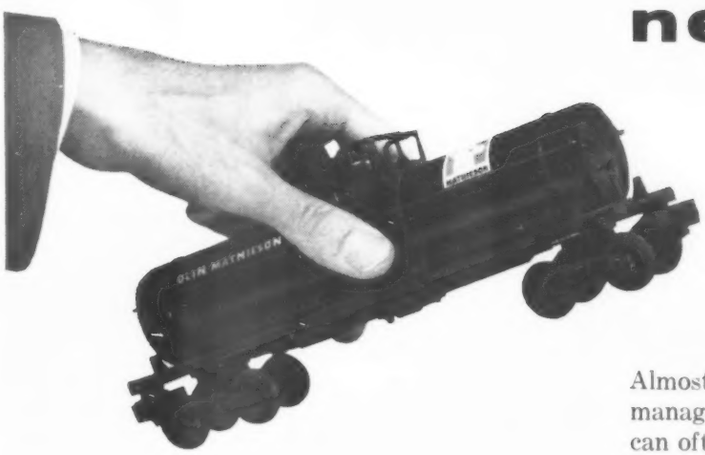
In this procedure, known as "tracheal intubation," the tube is inserted through the mouth into the windpipe of the victim. This eliminates the problem created by the tendency of the lower jaw to slip back and the soft fleshy parts of the throat to collapse and obstruct the airway. A seal is created around the outer surface of the tube which prevents secreted body fluids, which are abundant in nerve gas cases, from draining into the lungs and drowning the victim.

The tracheal intubation procedure may be used alone as well as in conjunction with the mask-to-mask resuscitation process. In the latter case the anesthetist-type mask is omitted, and the hose is attached to the tracheal tube. The casualty then may be transported on a stretcher while artificial respiration is still being supplied since the operator's hands are no longer needed to hold the victim's mask and to support his jaw.

The research program, conducted with volunteers by scientists at the Chemical Warfare Laboratories, has shown that this method can be used by non-professional laymen with a limited amount of training and practice.

Clinical studies that opened the way for this newest protective measure for American troops were conducted at Roswell Park Memorial Institute, Buffalo, New York, as a collaborative project between the Army's Chemical Warfare Laboratories and investigators working under contract with the Research and Development Division, Office of the Surgeon General. Major James O. Elam of the Chemical Warfare Laboratories, Army Chemical Center, Maryland, directed studies in connection with this project while on leave from the Roswell Institute, where he is Chief of the Department of Anesthesia. Other participants include: Dr. David G. Greene, Harry M. Dent, Professor of Clinical Research in Cardiovascular Diseases, University of Buffalo, who collaborated in blood-gas analyses; Dr. Clinton D. Janney and Dr. Robert O. Bauer of the Roswell Institute, who performed most of the resuscitations of human patients; Dr. John A. Clements and Captain Elwyn S. Brown, both on duty with the Chemical Warfare Laboratories, who participated in the design of the resuscitator and development of resuscitation procedures. Allan West and Eugene Sovinsky, also of the Chemical Warfare Laboratories, participated in design of the resuscitator and development of improved attachments.

CHEMICAL PROGRESS WEEK-APRIL 8-12



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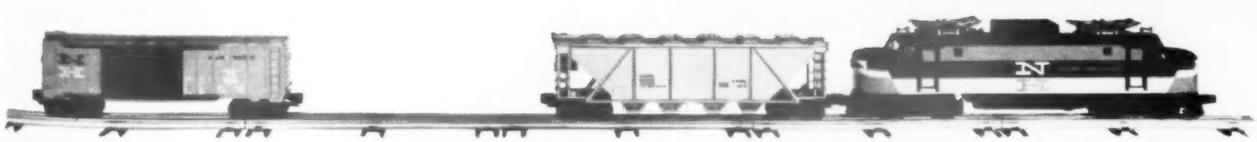

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4682

CHEMICAL, BIOLOGICAL AND RADIOLOGICAL

(Continued from page 19)

type of gas- and aerosol-filtering device designed to purify ambient air entering the shelter for ventilation purposes of the chemical, biological or radiological agents which are capable of being used in warfare. The collective protector incorporates a gasoline-engine-driven or electric-motor-driven blower for forcing the purified air under low pressure (approximately 0.6 inch of water) into the shelter in which it is installed. A simple type of collective protector is shown in Figure 3. This protector is described in detail in reference (6).

Accessory equipment includes such items as automatic electronic alarms (fig. 4), described in detail in reference (5), for detecting the presence of nerve gases, means for decontaminating personnel entering the shelter (preferably suitable showering facilities), contaminated clothing disposal, air pressure regulators with deflectors (fig. 6) for adjusting air pressures between main chambers and air locks, antiblast valves (fig. 5) influent to the protector and effluent to the structure and antibackdraft valves (fig. 7) for controlling the flow of air through the air locks. Antiblast valves and antibackdraft valves should be designed to enable adjustment of the air pressure in the area which they vent. The antibackdraft valve shown provides this feature. The antiblast valve shown does not. The antiblast valves and antibackdraft valves are designed to prevent influx of contaminated air when higher pressures occur on their exit sides due to blast or wind gusts. The antiblast valves are used generally where direct exposure to high pressures, such as nuclear blast, is indicated. They prevent the entrance of shock waves which would damage the filters and bring in contaminated air. The antibackdraft valves are used generally in situations where the pressures are sufficiently attenuated by other means before reaching the valve to prevent damage thereto, or in structures, vehicles, etc., which are inherently insufficiently blast resistant to justify the use of antiblast valves. Other associated Chemical Corps equipment normally includes gas masks, gas protection ointment, chemical kits for gas detection and identification, and soap and bleach for decontaminating purposes. Storage of water for emergency use in decontaminating is desirable.

Fig. 4. Gas Alarm

Fig. 5. Antiblast Valve

Advantages Afforded by Chemical Corps Consultation Service

As indicated above, data on the application and installation of Chemical Corps equipment in permanent-type shelters for protection against CBR attack are given in the various manuals and other literature supplied by the Department of the Army. However, in our society, both industrial and military, a time lag always exists between the acquisition of new engineering data and its inclusion in the appropriate engineering handbooks and manuals. Therefore, much of the information available in the referenced documents necessarily does not relate to the improved equipment for protection again CBR agents and detection of chemical and radiological agents, which are now in transition from the development to the production phase. Furthermore, usage information relative to the new CBR protective equipment is not included in the present documents. Literature giving information relative to the new equipment and usage thereof will be made available essentially concurrent with its type classification. Also, numerous details of design which require special consideration relative to the CBR protective aspects of the specific shelter under study are often encountered. Some of the related engineering problems considered by the Chemical Corps CBR consultant are air-conditioning and heating requirements, availability of water for decontamination purposes in an emergency, method of supplying air for diesel-driven electric power plants used for maintenance of communications and lighting, air-conditioning equipment and heating plants.

Some of the advantages of direct consultation service, in lieu of obtaining the extant information from manuals and other literature, are that the consulter is expeditiously apprised of the latest information available on equipment and the use thereof. The consulter is also assured of attention to details of design which might be overlooked in obtaining the CBR protective aspects of shelter design from applicable literature.

This consultation service makes it possible for other organizations to make the maximum effective use of Chemical Corps collective protectors, and their accessories and associated Chemical Corps equipment in ensuring that the CBR protective requirements of shelters have been adequately provided for.

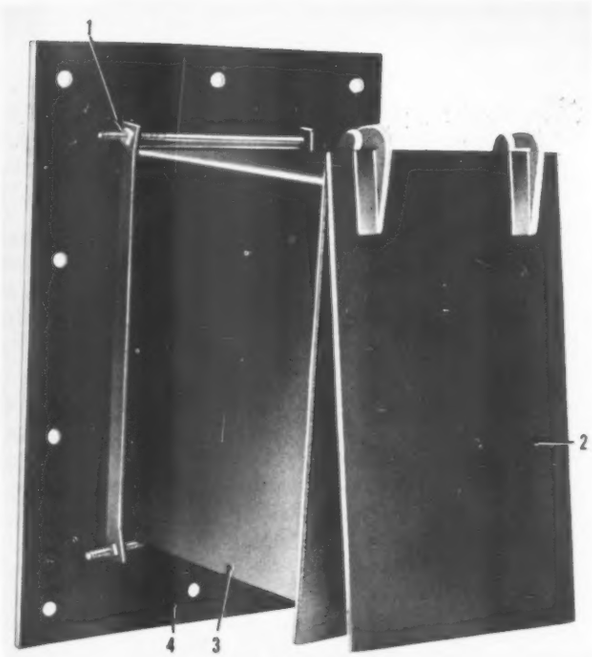

Fig. 7. Antibackdraft Valve

Testing

In the case of critical permanent-type shelters, testing to assure adequate aerosol protection is accomplished by the Chemical Corps Biological Laboratories by the use of harmless biological agents, and testing to assure adequate gas protection is performed by the Chemical Warfare Laboratories. Testing of less critical shelters may be accomplished by placing a smoke and gas source capable of sensory detection at the collective protector entrance, taking care to avoid buildup of carbon monoxide in the shelter from the smoke source, and observing for effects of the smoke and gas. This type test does not, however, assure complete adequacy of biological protection.

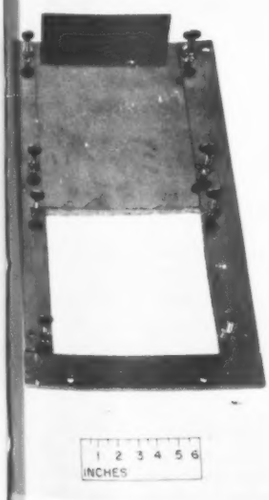

Fig. 6A. Air pressure regulator

Fig. 6B. Air Deflector

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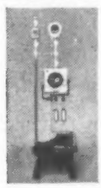

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Problems Normally Encountered and Their Solutions

The following problems and solutions, which are taken from comments made as a result of study of a specific shelter design, are generally typical of those normally encountered. The results of this particular preliminary study were selected as an example because of their brevity. Most recommendations are given in too great a detail for quoting here.

a. Decontaminating Rooms

The entrance door from the main corridor would easily be destroyed by blast. A blast-resistant personnel entrance closure should be provided and poppet-type antiblast valves should be installed over the closure.

Insufficient air is supplied to the decontaminating area. A means must be provided for supplying air in a quantity adequate to enable maintaining a positive pressure of 0.6 inch of water.

No means are provided for conducting purified air from the main corridor into the decontaminating rooms. An air pressure regulator or an auxiliary blower will be required for this purpose. Drawings are of insufficient detail to permit proper evaluation of the decontaminating area. Detailed drawings should be provided. Also, the type and an adequate number of shower heads should be specified for the washing area.

b. Main Corridors

Poppet-type antiblast valves should be installed above the blast-resistant entrance closures, and side views of the entrances should be shown in drawings. An air duct should be installed in the corridor to conduct contaminated air to Chemical Corps gas and aerosol filters. The duct entrance should be placed outside the blast closures and should be protected against blast in the same manner as is the main air shaft. This arrangement will permit use of the corridor as an auxiliary air supply entrance if the main air shaft is rendered unusable.

c. Power Plant Room

The prefilters should be changed from the effluent to the influent side of the collective protectors so that they can prevent plugging of the high-efficiency Chemical Corps aerosol filters by dust. The pre-filters should be of commercial fiberglass type (similar to American Air Filter, Type G Mat), and installed as close to the effluent side of the poppet valve assembly as possible. This type prefilter, of proper size, should be delineated by the specifications.

d. Alarms

An automatic electronic alarm for detecting nerve gases, similar to the Chemical Corps E21 gas alarm, should be installed with the probe inserted in the air stream effluent to the gas and aerosol filters. The alarm will detect early penetration of nerve gases so that the gas filters can be changed before they permit dangerous concentrations to pass.

e. Test Canisters

Six test canisters similar to the M11 canister, a component of the M9A1 field protective mask, should be installed parallel to each Chemical Corps gas filter unit. The pressure drop through the test canisters should be adjusted to equal that of the gas and aerosol filters which they monitor. Every six months one of the test canisters should be removed and tested for residual life, and the pressure drop readjusted for the remaining canisters if found necessary. The test canister will provide information as to the condition of the sorbent bed of the main filter units, thereby indicating when the gas filters should be replaced.

f. Bypass Ducts

The bypassing of the filters, as shown in the drawings, is undesirable in that it is advisable to provide filtered air to this particular shelter at all times, since a bypass duct would present a constant danger in the event of a covert BW attack.

g. Auxiliary Air for Power Plant Room

Air intakes and exhausts for the diesel engines should be designed to handle directly the contaminated air from outside of the shelter in order to reduce the demand for air from the Chemical Corps filters. Chemical and biological air contaminates will be destroyed by the heat of combustion when passing through the engines. Normally, radioactive particles from fallout are not expected to present a hazard by collecting in the engines. However, prior to performing maintenance or other work around the engines, it should be determined that radioactivity does not exceed the safe level. The highest degree of radioactivity in the engine system would be expected to be found in the engine intake filters. The auxiliary air supply, suggested under the heading "Main Corridors", can supply combustion air to both the diesel units and the oil-fired heating plant boilers.

h. Drawings

Detailed cross-sectional drawings should be provided of base mounts and the ducts to and from each gas and aerosol filter, including the control valves therefor. A drawing, showing details of the air duct to the diesel engines and the exhaust therefrom, is also required.

i. Precaution

The airflow through each gas and aerosol filter should not exceed the rated 5,000 cubic feet per minute.

j. General comments

Space for the collective protectors and for decontaminating rooms appears adequate.

Drawings are not in sufficient detail to permit thorough evaluation of the CBR protective aspects of the shelter.

The specifications should delineate requirements for the installation of an automatic gas alarm (fig. 4) integrated into the system of automatic closure triggering devices, to ensure that the closures operate also when only gas is present.

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4. Department of the Army Technical Manual 3-350, "Improvised CBR Protective Shelters"—September 1954.
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The manuals referenced in 1, 2, 3 and 4 above contain information necessary to enable construction of protective shelters. They also reference numerous manuals that deal specifically with the CBR protective aspects of shelters.

AIR FORCE IGY

(Continued from page 9)

small payload and uncontrolled direction of rocket flight, which dictate that experiments must be simple and firings confined to unpopulated regions, such as ocean areas.

It was likewise known that the Air Force (AFCRC) has under development the Rockaire, a 40-lb. payload rocket launched from a fighter aircraft at the peak of its vertical ascent. A second aircraft contains the receiving equipment to pick up the radio signals from the rocket and thus completely eliminates the need for a ground installation. The only limitation on this sounding system is the range of the fighter aircraft from a suitable airstrip.

Since the independence of permanent ground stations in these probing systems has to be purchased at the cost of smaller payloads and lower altitude capabilities than the Aerobee and Aerobee-Hi rockets (70 and 150 miles), and in recognition of the development status of the Rockaire, it was decided to establish a new permanent facility primarily for launching Aerobee and Aerobee-Hi rockets. An exciting opportunity was provided when the Canadian Government invited the U. S. to conduct a portion of the IGY rocket program at Fort Churchill, Manitoba. Plans were developed for the proposed Fort Churchill site and were later endorsed by the U. S. National Committee. On 21 March 1955 the Department of Defense assigned responsibility to the Army to establish, operate, and maintain a rocket launching facility at Fort Churchill for the IGY rocketry program.

Fort Churchill (lat. 58° N.) is a Canadian army post, used as an Arctic test station, because of the bitter persistent cold and windchill effect on human beings.

It is in this environment that a complete rocket research facility has been established. It includes an instrumented firing range about 50 by 100 miles in dimension, with a launch area containing a 100 ft. enclosed launching tower for Aerobee and Aerobee-Hi rockets and a launching building for Cajun rockets, which have been developed by the National Advisory Committee for Aeronautics and are fired with a modified Nike booster, and an ionosphere station with 60-foot tower.

Associated ground stations will be established for radar tracking of rockets, receiving the telemeter signals from rockets, and positioning rockets by DOVAP, which operates on Doppler principles.

A second ionosphere station with 60-foot tower and a sound-ranging station will be located downrange, and ballistic cameras will be installed crossrange.

Airlift of personnel as well as supplies and equipment to and from Fort Churchill is being coordinated by the Air Force (AFCRC). The airlift is being provided by Military Air Transport Service from Winnepeg to Fort Churchill.

The upper atmosphere program finds its justification in the need for empirical data which ground experiments cannot provide. In addition, direct probing techniques yield new kinds of data. For example, solar radiations of certain wavelengths are wholly absorbed in the atmosphere and thus cannot be studied on the ground because they never reach the ground. The only way to study them is to penetrate the atmosphere to a point above the region of their absorption.

These data are required to test existing theories and generate new theories on such matters as the formation of the ionosphere and the aurora; changes in the earth's magnetic field; solar-terrestrial relationships, especially as they are significant for low-altitude weather; and the energy balance of the upper atmosphere.

The American program at Fort Churchill includes six pre-IGY flights, which have been completed, and seventy-five rocket flights (Aerobees, Aerobee-Hi's, Cajuns) during the IGY period. The agencies firing these rockets are the Geophysics Research Directorate of AFCRC, Naval Research Laboratory, Ballistic Research Laboratories, and the Signal Corps Engineering Laboratories; with the University of Michigan as contractor both to AFCRC and the Signal Corps, the University of Utah also a contractor to AFCRC, and State University of Iowa a contractor to the Naval Research Laboratory.

The Air Force Aerobee program at Fort Churchill consists of three experiments to measure pressure, temperature, and density with alphatron gages; two experiments to measure dayglow, using photomultipliers and filters; and three experiments to measure the electron density in the ionosphere by means of a rocket-borne pulse transmitter. The Cajun program consists of experiments to measure pressure, temperature and density.

Parallel to the Fort Churchill program will be the continued use by the Air Force of Holloman Air Force Base, where AFCRC will fly two dayglow experiments, two solar UV spectrum experiments with sunfollowing spectographs, and three rockets to measure electron density in the ionosphere.

In addition, if the Air Force development proceeds according to schedule, the Rockaire will be used by the Geophysics Research, Directorate, AFCRC, to measure night and day airglow, pressure, temperature, density, and possibly electrical conductivity, at various northern locations, such as Alaska, Thule Air Base, Greenland, and Fort Churchill.

Satellite Program

The announcement by President Eisenhower in July 1955 that the U. S. will provide an unmanned earth-circling satellite for IGY scientific purposes, although dramatic and challenging to the imagination, in reality was the natural and necessary culmination of the rocket program, arising from a limitation of the rocket itself as a vehicle. Since rockets are at any given altitude for only seconds during their trajectory and enjoy a total lifetime of only a few minutes, they cannot provide the continuous data required to measure fluctuations or variations with time of atmospheric phenomena. A satellite will make possible the continuous and relatively long-term observation of such atmospheric properties and processes. In addition, the experience gained in the design, development, and operation of the ten planned scientific satellites will make a major contribution to the engineering of more sophisticated unmanned and manned satellites, space stations, and space vehicles.

On 9 September 1955 the Department of Defense assigned to the Navy Department (further delegated internally to the Naval Research Laboratory) the management responsibility for Project Vanguard, which is the joint-Service project for developing under contract both the satellite and the rocket vehicle and associated equipment necessary for placing the satellite in orbit and tracking and communicating with it.

The satellite will be a hollow magnesium sphere, 20 inches in diameter. Its total weight will be 21½ pounds, of which about two pounds are available for scientific instrumentation and its power supply. The difference in weight is taken up with the satellite's physical structure, transmitter and power supply for the tracking system, and transmitter and power supply for the telemeter system. The rocket assembly to carry the satellite to altitude consists of three stages. The first stage is a 27,000-lb. thrust, liquid-propellant rocket. It will burn out after two minutes at about 40 miles altitude. The second stage is a liquid propellant rocket similar to the Aerobee-Hi. This stage will burn out at 130 miles altitude. When the rocket assembly reaches an altitude of 300 miles in its coasting

phase and has been positioned parallel to the earth's surface, the third stage, a spin-stabilized, solid propellant rocket, will accelerate the satellite to its orbital speed of 18,000 mph, which will balance the pull of the earth's gravitational field, and enable the satellite to encircle the globe about every 100 minutes. Because the orbit will be elliptical rather than circular, to simplify guidance and control, the satellite may vary in altitude from a minimum of 200 miles to a maximum of possibly 1400 miles.

The rocket vehicles will be test-fired at the Air Force Missile Test Center, Patrick Air Force Base, Cape Canaveral, Florida, and the ten operational satellites are scheduled to be launched from the same site beginning in early 1958. The satellites will be observable in the United States.

Tracking the satellite is required to obtain data for during-flight calculations to compute and predict flight paths in the immediate future, in order to facilitate and insure securing further observations by Minitrack (radio tracking) stations, precise photography stations, and networks of visual observers. Tracking data are also required to permit the after-the-fact difinitive calculations from which will be derived all the scientific conclusions which may be deduced on the basis of all available observations.

Minitrack is a phase comparison angle tracking radio system for tracking the satellite. The satellite will have a miniature transmitter. The signal will be received and tracked by a line of nine ground stations.

The satellite will be observed once per revolution from one or another of these stations and data will be radioed immediately to a computing facility which will determine satellite ephemerides; that is, a table of predicted locations of the satellite at regular intervals of time.

Minitrack will also be used for telemetering data from the satellite to a ground recording station.

As a second means of tracking Vanguard satellites, the Smithsonian Astrophysical Observatory has been assigned responsibility for a program of optical tracking, which consists of two parts: volunteer visual search and tracking, which is of a low order of accuracy, and a high precision photographic tracking program to be carried on by a network of about twelve stations.

The visual observer program is called Moonwatch. Its primary objective is to make sure that an observable satellite will not pass over a station without being observed with acceptable accuracy. Volunteer groups will be organized in various geographical areas throughout the world and will transmit their data to a central computing facility.

Moonwatch will obtain the first and last significant visual observations of the satellite. Although its accuracy will be far below that of Minitrack, the early satellite tracking is necessary for calculating the predicted satellite locations, essential for aiming the photographic Schmidt telescopes that will make the precision observations.

The satellite can be observed optically only when it appears during evening or morning twilight, when it is illuminated by the sun and the observer is in shadow.

The scientific experiments to be flown on the satellites will be selected by the USNC-IGY Technical Panel on Earth Satellite Program. The experiments will yield information on (1) air density, by observing the drag on the satellite; (2) the earth's crust by observing small perturbations in the orbit due to variations in the earth's gravitational field which reflect mass distribution; (3) the shape of the earth, and improved determination of longitude and latitude, by synchronized observations of the satellite; (4) internal pressure and internal and skin temperature, to characterize the satellite's own operating environment; (5) meteoritic particles, which may contribute to ionizing the atmosphere in the E-region and may erode the skin of the satellite; (6) solar ultraviolet radiation (Lyman alpha) and x-radiation, to determine the influence of solar flares on this emission from the sun; and (7) cosmic ray intensities.

Although final selection of specific experiments from the more than thirty already proposed and their order of priority for flight will probably not be made until the satellite components and experimental instrumentation have been developed and tested, a working priority list of experiments has been adopted. At the present time, two Air Force (AFCRC) experiments have been accepted for inclusion on this list. The first is the detection of extreme ultraviolet solar radiation (1050-500A) by photoelectric techniques, rather than by the more usual photon counters or ionization chambers. The second is the measurement of the spatial and size distribution of interplanetary matter by detection of the acoustical energy generated upon impact with the satellite.

OTHER AIR FORCE PARTICIPATION

As in the rocketry and satellite programs, the U. S. National Program includes comprehensive activities in the other eleven scientific areas designated by the IGY. A brief summary of each area and its related Air Force participation follows.

Meteorology

The purpose of this program is primarily to increase knowledge of the structure and large-scale motions of the atmosphere, especially above the tropopause. Since this requires information on the intensity and mode of exchange of energy, momentum, water vapor and mass flow between polar and tropical regions, between troposphere and stratosphere, and between the hemispheres, special effort will be made to obtain balloon soundings of temperature, pressure, humidity and winds to 30 km (100,000 feet), especially along the 70-80° W meridian, where a line of stations will provide a meteorological cross section of the atmosphere from pole to pole.

This program is primarily a U. S. Weather Bureau effort. Air Force participation will include the collection of upper air data from its rocket exploration program at Fort Churchill and Holloman Air Force Base, collection of standard weather information at Air Weather Service ground stations, and an extensive aircraft weather reconnaissance program.

Geomagnetism

This program seeks to collect detailed data from existing and new observatories, especially in the auroral zones and the equatorial zone, in order to provide a more comprehensive understanding of the upper atmosphere electric current systems which are believed due to burst of energy from the sun.

Although this is primarily a project of the U. S. Coast and Geodetic Survey, the Air Force will measure geomagnetic time variations at five field stations over a wide latitudinal range, and will attempt to determine the sources of such fluctuations.

To enhance the IGY geomagnetic and cosmic ray programs the Air Force (AFCRC) conducted an airborne observation program in late 1956 to determine the location of the geomagnetic equator as seen by cosmic rays, which previously had been only calculated from widely separated surface observations of the terrestrial magnetic field.

Aurora and Airglow

The purpose of this program is to investigate the excitation of the polar aurora, generally thought to be primarily excited through bombardment of the atmosphere by ionized particles from the sun, and the airglow, thought to result for the most part from chemical reactions in the upper atmosphere; to determine the distribution of these optical phenomena; and to study them with respect to other geophysical events occurring simultaneously.

For airglow studies, data are required on the temporal and geographical variation of intensity of this radiation from the night sky. A chain of stations will be equipped with Roach photoelectric photometers as modified by Manring.

The Air Force has developed a broad program in this area, under the leadership of AFCRC. The rocket programs at Holloman Air Force Base and Fort Churchill will provide significant high-altitude data. In addition to the Antarctic program, patrol spectrographs, all-sky cameras, and visual observations will be used at the AFCRC Sacramento Peak Observatory at Sunspot, New Mexico; at Shingleton, Michigan, and Williams Bay, Wisconsin (Yerkes Observatory), by the University of Chicago under an Air Force contract; at Saskatoon, Saskatchewan, by the University of Saskatchewan under Air Force contract (permitting direct correlation of Canadian and U. S. data); and at Dunedin and Invercargill, New Zealand, by Carter Observatory under Air Force contract. Similar equipment plus radio astronomy techniques are planned for Thule Air Base under the technical direction of and operation by AFCRC. Finally, scanning photometric and visual observations will be conducted at AFCRC itself in the Boston area.

Ionosphere

The ionospheric physics program includes synoptic observations by means of vertical incidence soundings which probe the ionosphere over the station.

The Air Force program consists of the continuing AFCRC contractual work at the University of Puerto Rico on tropical ionospheric motions or winds; a cross-modulation experiment to yield ionospheric temperatures at about 60, 120, and 180 miles; and an intensive flight program over the Arctic with one or two ionospheric recorders aboard C-97 aircraft to expand the existing AFCRC project for collection of data over normally inaccessible areas. In addition, the American Radio Relay League, under the guidance of AFCRC, will encourage radio amateurs to conduct tests of long distance two-way communications and will screen, classify and process the raw data for analysis.

Solar Activity

The purpose of this program is to compile detailed and comprehensive records of the activity of the sun, especially sunspots, flares, plages, coronal emissions, solar magnetic fields, and radio-wave emissions at various frequencies, during the IGY period of sunspot maximum.

Existing photographic programs or patrols will be continued by various observatories.

The Air Force program consists of coronal-emission patrol, flare line profiles, indirect flare patrol, photographic flare patrol, plage-frequency spectra, radio-frequency spectra, and special solar observations at the AFCRC Sacramento Park Observatory. The solar experiments of the rocket research program at Holloman Air Force Base are an important part of the overall program. A major effort will be made by AFCRC to observe the solar chromosphere at various stations in the Pacific during the 12 October 1958 total eclipse of the sun.

Cosmic Rays

This program is designed to obtain data on the mass and energy spectrum of the primary cosmic radiation, especially the low-energy end of the primary spectrum; on fluctuations of cosmic ray intensity; and on the variation in intensity due to latitude. To study the primary spectrum, a series of nearly simultaneous flights will be made at various latitudes with both balloons and rockets carrying Cerenkov counters, proportional counters, pulsed ionization chambers, Geiger counters, and photographic emulsions.

The Air Force program in cosmic radiation will be carried on wholly contractually by such institutions as the University of Chicago, University of Maryland, and New York University. Data will be used by AFCRC in its continuing geomagnetism, auroral, and ionospheric projects.

Longitude and Latitude

The purpose of this program is to determine astronomical longitudes and latitudes by observing stars with astrolabes, timed with quartz-crystal clocks, in order to ascertain differential shifts between continents; and to undertake a moon-photography program to obtain data for problems of uniform time, the irregular rotation of the earth, and the size and shape of the earth. The Markowitz dual-rate moon position camera takes a simultaneous exposure of the moon and surrounding stars. The Air Force is interested in this technique for geodetic purposes. This program will be carried out by the U. S. Coast and Geodetic Survey and the U. S. Naval Observatory.

Glaciology

The glaciology program seeks to conduct detailed field investigations in the Western U. S., Alaska, the Arctic, Greenland and the Antarctic to record the status and behavior of glaciers in the IGY period for comparison with observations made in the past and in other parts of the world. These studies will include reconnaissance by terrestrial and aerial photogrammetry.

Oceanography

This program includes the establishment of new tide gage and long period wave recording stations in equatorial and southern hemisphere oceanic areas, to measure seasonal fluctuations in sea level, changes in temperature and salinity to depths of a thousand feet, and waves of periods of five to fifteen minutes.

Operation Deep Current consists of oceanographic cruises to study the deep circulation of water.

The Arctic regional program has recently been expanded by the planned establishment of two ice floe stations on the Arctic ice pack. A comprehensive and integrated program is being formulated to exploit the possibilities of these stations. In meteorology, for example, complete surface and upper air observations are scheduled for both stations.

Air Force participation in ice floe station activities consist of an auroral program of visual, photographic and patrol spectographic observations of the incidence of auroras, and two oceanographic projects.

Seismology

The seismic program is concerned with seismic exploration of the crustal surface of the solid earth, including sea, coastal, and continental exploration; earthquake studies; and Antarctic studies. The Air Force is interested in the seismology program but has no projects in it.

Gravity

The purpose of the gravity program is to extend current knowledge of the earth's gravimetric field, to relate existing gravity data to a common base, and to ensure

(Continued on page 37)

CHEMICAL WARFARE SUPPLY SWPA WORLD WAR II

By IRVING R. MOLLEN, LT. COL., CmlC.

(While this interesting account of CWS Theatre of Operations supply activities in World War II deals with the Southwest Pacific Area, Colonel Mollen's discussions of problems he encountered will no doubt have a familiar ring for chemical officers who served in similar capacities in other Theatres. The article is being presented in two installments.—Ed.)

DURING THE EARLY STAGES of World War II in the southwest Pacific, the Chemical Warfare Service supply units presented a picture of "having very little and having to move it very far." The successful accomplishment of the CWS mission in spite of these difficulties was due to the untiring efforts of the entire Chemical Warfare Service of Supply organization, under the able direction of Colonel William A. Copthorne.

Chemical Warfare Section commenced operations early in 1942 with the Office of the Chief being assigned to SOS Headquarters in Melbourne, Australia, and other Chemical Warfare officers being assigned to the seven Australian bases under SOS control. Within a short time, Bases 5 and 6 at Perth (Western Australia) and Adelaide (South Australia) were closed due to lack of activities, and their responsibilities were transferred to other bases. A sub-base of Base Section 3 (Brisbane) was organized early in 1943 at Rockhampton, Queensland, and a similar sub-base for Base Section 2 (Townsville) was established at Cairns, Queensland. In addition to these SOS bases, the Air Force established a CW toxic gas yard and small depot at Charters Towers in Northern Queensland for storage of chemical munitions and supplies required for their own use. As the war progressed northward, the Office of the Chief Chemical Officer, with the rest of the SOS Headquarters, moved to Sydney, then later to Brisbane, subsequently to Hollandia, Leyte, Manila, and finally to Japan after V-J Day.

Depots were established in these bases with the maintenance stocks of incoming units forming the initial stockage. The installations were operated by a detachment of the 62nd Chemical Depot Company assisted by the 10th Chemical Maintenance Company and the 28th Chemical Decontaminating Company. These companies, and the 42nd Chemical Laboratory Company, were the only CW SOS units in the theater in the early days. In addition, detachments of the 62d Chemical Depot operated the Theater Toxic Gas Yards established at Melbourne, Brisbane, and Townsville. A great deal of credit is due the officers and personnel of these units for the efficient manner in which they operated the depots and performed maintenance, surveillance and repair work in spite of the many obstacles encountered.

AS THE WAR MOVED northward, depots were often by necessity established where there was no permanent type of warehousing or storage area available. As a consequence, it was necessary to rely mainly on native-type construction or modifications thereof, which were quickly and easily erected and were very adjustable to enlargement and modifications, and to climatic conditions. Proper storage continued to be one of the key problems of the theater. In the early days, the problem was greatly aggravated by the inadequate packaging and types of containers received from the United States, causing large losses of material, regardless of the type of storage area. As time went on, improvement in the waterproofing and packaging of material eased this problem a great deal. However, even at its best, storage in forward areas left much to be desired.

In these areas, extreme variations in climatic conditions, such as temperature and humidity, presented far more complicated and vexing problems than anything previously conceived in storage and maintenance of equipment. For example, M1A1 flame throwers, checked and tested prior to shipment to New Guinea, failed to function in combat due to moisture rapidly permeating the electrical system. Cartridges and rings for 4.2" mortars, which were not shipped in waterproof containers, caused malfunctions or duds. The glass lenses in Australian gas masks were susceptible to fungus and were rendered unserviceable. The entire stock of DANC had to be repackaged due to deterioration of containers caused by climatic conditions, and the components were packaged in separate containers. Chloride of lime in all types of containers, whether stored outside under tarps or in native-type depot buildings, usually deteriorated within a period of six months to a year. Australian-manufactured chloride of lime, received through reverse lend lease, showed less deterioration.

However, lime which was deteriorating was seldom destroyed. Stocks which were not suitable for future Chemical Warfare issue were supplied to the Quartermaster and Engineers. The chlorine content was sufficiently high for their use. In many cases, utilizing their native horse-trading abilities, CW supply officers used such material for barter purposes to the advantage of the Chemical Warfare Service.

Continued surveillance to minimize these unsuitable conditions was generally the responsibility of the Technical Officer, Office of the SOS Chemical Officer, assisted by the Supply Branch. Actual surveillance testing was performed by the various CW unit labs or lab detachments under the control of the 42nd Chemical Laboratory Company. Reprocessing and repacking was done by chemical units assigned to the Base.

TRANSPORTATION BETWEEN bases presented a much greater problem than one would normally realize. Due to various contributing factors, Australia does not possess the vast improved network of roads nor the efficient railway system found in the United States. With the exception of a few improved two-lane roads, most roads, other than those near the large cities, are little more than wagon trails. Hence, movement of supples to various parts of Australia and New Guinea was

most difficult and often delayed. A shipment via rail from Melbourne to Townsville through the most populated part of Australia required loading and unloading of the shipment from one box car to another twice, due to different gauges of track used in the various states. Air travel, however, was on a comparative level with that in the United States and was, therefore, a very popular means of travel and shipping. In New Guinea, all shipments between various bases had to go either by boat or by air as there were no connecting roads through the jungle.

TO OFFSET THESE OBSTACLES, and to keep supplies going forward to insure availability when and if needed, the theater policy was to equip all units bound for New Guinea or other combat zones with their 30-day maintenance supplies. The latter items were turned over to the Chemical Officer of the new base upon arrival. Practically all initial stocks of Chemical Warfare Depots in forward areas were received in this manner.

Availability of shipping and air space always remained a problem in New Guinea and the rest of the forward area bases. Base Chemical Officers soon learned to take advantage of any available shipping space, and in a very short time after being notified, they could fill any nook or cranny offered. The condition was somewhat alleviated in the Philippines where we were able to take advantage of the limited road net and railroad system there. In the vast oceanic areas that separated Australia from the Philippines, shipments to a base 100 to 200 miles away often had to wait for weeks or months for available space. Shipments made to forward installations from bases in areas left behind by the forward movement of combat often took six months to a year to complete.

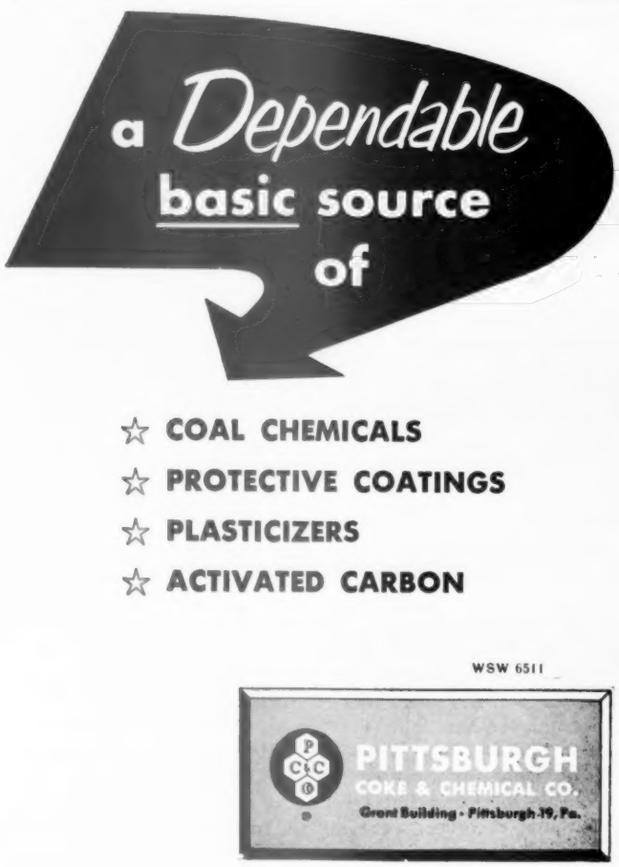
Receipt of shipments from the United States also affected operations. The small volume of tonnage Chemical Warfare received from the States as compared to the larger supply services such as Quartermaster, Engineers, and Ordnance, prevented us from indicating the base at which Stateside ships should dock. In many, many cases, this put CW cargo in ports least desirable, requiring reshipment to get supplies to needy organizations. In other cases, we did manage, where vital combat cargo was involved, to get critical shipments into the necessary ports through much needed assistance received from the Army commanders through their chemical officers.

Keeping the forward areas supplied and not being trapped with large quantities of supplies in rear areas required a great deal of anticipation and prior planning on the part of the Supply Section of the Theater Chemical Office. In reviewing the overall situation, it is believed that the CWS was much more successful in this field than most of the other services. Prior planning by officers such as Colonel John Youngman, Major A. Williams, and others, paid off time after time.

VERY SELDOM WAS A serious complaint lodged by the Armies or the Air Force against SOS or the Base Chemical Officer concerning the movement of equipment and supplies to combat and other units. In the few instances when a complaint was voiced, mitigating circumstances rather than neglect were usually found to be the cause.

In order to insure the issue of needed critical items to units with the highest combat priority, arrangements were made to coordinate such issues through the chemical officers of the various armies and air forces concerned. This worked to mutual advantage and gave the chemical officers of the armies, corps, air forces and the AAA, who had the most complete picture of the tactical situation, a say in the issue of weapons, munitions, and equipment in short supply, thus insuring maximum and effective utilization. It was the policy of the SOS to keep these officers informed of the various requisitions for critical and new items sent to the States. Upon receipt of needed items, allocations were made to various armies which, in turn, advised which units were to be supplied. Issue of chemical mortars, mortar ammunition, flame throwers, and napalm were some of the items controlled in this manner. All maintenance stocks of such critical items were kept under control of the Chief Chemical Officer of SOS to make replacement issues as needed. Often, USAFFE authorized special issues which were made from maintenance stocks. This system of priorities worked to the advantage of the tactical chemical officers, a number of whom were not too familiar with supply procedure, and it insured their receipt of needed components and spare parts.

Periodically, lists of critical equipment and supplies were published and distributed to all concerned. These lists were constantly revised and the items thereon kept to an absolute minimum to insure effectiveness. In extreme emergencies, base chemical officers could and did make issues of critical items, later notifying SOS by wire of action taken. Spare parts for critical items, except those in very short supply, were issued by base chemical officers without any recourse to SOS. Such parts, in many cases, enable practically complete rebuilding of critical equipment.



Issues of chemical munitions were also coordinated with the chemical officers of armies and the Air Force to insure that all organizations participating in operations were supplied. The degree of control was dependent upon availability. In instances where stocks were plentiful, issue was arranged with the chemical officer of the base concerned. Munitions in critical supply, on the other hand, were issued like other critical items.

Basis of issue of chemical munitions was controlled by Unit of Fire and Day of Supply Tables of Chemical Munitions published by Headquarters USAFFE (Administrative Hq. of GHQ). These tables were based on combat experience of the tactical units and were the results of the coordinated efforts of the tactical chemical officers in conjunction with SOS. They were revised periodically as required. In addition, combat units were required to submit CW ammunition expenditure reports to SOS through the chemical officer of their higher headquarters. These reports were useful as a basis for computations in helping to maintain proper level of supply of all munitions and advising the States of ammunition expenditure.

To insure that troops had in their immediate possession, or had available in the immediate vicinity of the combat zone, adequate stocks of supplies and equipment necessary for defense against chemical attacks, the following general procedure was adopted:

a. *Supply.*

Each task force commander usually established the quantities and levels of the chemical equipment and supplies he desired to be taken by his troops participating in the operations and for maintenance stocks. These items were usually dropped on the beachhead upon arrival. Masks, however, were not usually dropped until it was determined insofar as possible the status of the enemy's potential for gas warfare. This system seemed to operate to the satisfaction of all parties concerned as:

(1) It provided for emergency supplies being available in the event of chemical attack, and

(2) It helped move stocks forward from rear areas.

b. *Troops.*

SOS CW troops were usually assigned to the Task Force Commander in charge of the operation to establish depots and to be of technical assistance if required. He, in turn, allocated them to the major tactical units under his command. Upon landing, these units established depots and retrieved CW items of supply which had been dropped on the beach by troops, or had been received from vessels, and arranged for their storage and issue, along with their primary mission of troops support. After the area had been secured, these troops, in due time, reverted to SOS control and became Base personnel.

Every possible precaution was taken to insure that, in the event of gas warfare, the SWPA Theater would be prepared both offensively and defensively. Periodically, by agreement between the Chief of CWS, Washington, D.C., the Theater Commander, and the Chief Chemical Officer of SOS, levels of bulk toxics and chemically filled munitions of all types were constantly reviewed and, as potential requirements increased, stocks were requisitioned and received from the States. Additional reserve stocks were maintained in the United States to be available for immediate shipment if necessary. All such shipments received were stored in designated locations in the theater under control of SOS Headquarters.

Stocks therein were kept under constant surveillance to insure serviceability and immediate availability to the air and ground forces. Such storage areas were established only with full concurrence of the Theater Commander.

In order to prevent any possibility of toxic gas shells or bombs being used in error in the combat zone, no shipments of such munitions or bulk containers were made to bases in the combat zones. Chemical Warfare also worked very closely with Ordnance on the required levels of toxic munitions and shells stored and issued by that service.

Stock levels of supplies and equipment needed for defense against chemical attack were also constantly reviewed and necessary quantities requisitioned and received from the United States to maintain these levels. Constant liaison was also maintained with the Quartermaster to insure immediate availability of impregnated clothing and a close surveillance was kept on all such stocks due to rapid deterioration of this type of clothing. The surveillance was under the supervision of the technical officer of the SOS Office, and actual tests were performed by various laboratory detachments.

Very early, through tactical and logistical experience, it was determined that in various instances the TO&E (Tables of Organization & Equipment) allotment of equipment and supplies to certain units was either inadequate or in excess. Where a needed item was not authorized or the quantity of the authorized item was found inadequate, requests for allotments or increase were normally sent through channels to USAFFE. If requests were justified and stocks were available, or could be made available in the future, such requests were approved. These additional authorized allowances were then used as the basis of requisitions sent to the States for increased quantities of the item concerned While not required to do so, GHQ and its administrative Headquarters, USAFFE, took a very practical approach to such requests and always consulted SOS relative to commitments and availability.

The relationship between the headquarters and CW SOS was very cordial and considerable attention was given to the opinions of SOS chemical office by USAFFE. It was the general policy of CW SOS to "sell" the use of CW weapons, equipment, and supplies which could be utilized for non-gas warfare, and any reasonably justified request consistent with availability and to the interest of the service normally received concurrence.

A perfect example illustrating this procedure was the increased use of the flame thrower. Originally, TO&E allotment of this weapon was twelve to a division, but the number authorized was increased as the requirements became apparent, until at one stage of the war the division allotment was 108.

For intelligent submission of requisitions to the Chief's Office in Washington, D.C., a duplicate of the set of stock records maintained in the bases was maintained by the supply section of CW SOS. These records enabled SOS to know the stock status of all items, to keep abreast of theater needs, and to make emergency issues if needed. Posting was kept up to date by the daily receipts of duplicate tallies from the bases, showing all issues and receipts. These tallies were also utilized by SOS to maintain a close check on all items received from the United States and to minimize the losses of such equipment. This system kept the requirement for physical inventories to a minimum.

(To be concluded)

NERVE GAS POISONING

(Continued from page 25)

Possibility a-3 has been attacked *in vitro* by studying the rates of reaction of various compounds with nerve gases. The most rapidly reacting compounds now known belong to the group of oximes. A number of these oximes have been tested in mice and rats for ability to prevent poisoning by sarin. The correlation between the *in vitro* reaction rate and the protective value *in vivo* is poor, the coefficient of rank correlation for 7 oximes for which both types of information are available being -0.21. Three of the most active oximes *in vivo* as phophylactic agents are 2-oximino-3-butanone (DAM), 2-oximino-3-pentanone and 2-oximino-acetamide. The last of these is the only one which is strikingly active *in vitro* in reacting with sarin. Yet DAM is able to protect about one-half of a group of rats against 20 LD50 of sarin.

Possibility of b-2 also is related to the oximes, but to a somewhat different group of oximes than those just discussed. Indeed, DAM has very little therapeutic value despite its pronounced prophylactic activity. The same compound discussed previously as being effective in overcoming nerve-gas-induced neuromuscular block, 2-PAM, has been reported to be extremely active *in vitro* in reactivating cholinesterase inhibited by DFP, TEPP or sarin. It is not yet certain that this is the sole mechanism of therapeutic action of 2-PAM *in vivo*, but the compound has been found to produce a regeneration of about 14% of the cholinesterase of the limb muscles of the rat after its inhibition by sarin-poisoning of the animal. The cholinesterase level in the brain is not affected significantly by 2-PAM, which may mean that this compound, like other quaternary compounds, does not cross readily the blood-brain barrier.

Despite the promise apparent in DAM, 2-PAM and other drugs as adjuncts to atropine in the prophylaxis and therapy of nerve gas poisoning, the corner stone of protection against the nerve gases remains adequate dosage with atropine. Coupled with the use of atropine, particularly in therapy of poisoning, go the importance of insuring a patent airway in the poisoned individual and the necessity for effective pulmonary ventilation in the paralyzed man. Early and adequate dosage with atropine and effective artificial respiration probably can save men from poisoning by many LD50 doses of nerve gases.

HONOR GRADUATE OF FT. BRAGG SCHOOL

U.S. Army Photo

If it's radioactive, this gadget will warn you. Sfc. Donald R. Gannon, recent honor graduate of the Fort Bragg CBR School discusses the test meter with Brig. Gen. William R. Currie, Asst. Chief Chemical Officer, who presented diplomas to 87 students who took the course in Chemical, Biological and Radiological Warfare protection methods. Gannon is a member of the 82nd Airborne Div. band and top man of the graduating class.

AIR FORCE IN IGY

(Continued from page 33)

that future gravimetric work has the same standard of reference.

Although the Air Force has at present no formal participation in this program, the IGY pendulum measurement program is a continuation by the University of Wisconsin of its current work under contract to AFCRC.

World Days

Since the 18-month period of the IGY is a long time for sustained geophysical observations, four types of "days" or series of "days" have been designated for special observational efforts. Three or four Regular World Days per month have been specified in advance. These will be two consecutive days at new moon, with the other(s) near the quarter moon and prominent meteor showers. World Meteorological Intervals, which are series of ten consecutive days each calendar quarter, including the solstice or equinox day and also three Regular World Days, have also been established. For transient phenomena which cannot be forecast, a world-wide Alert, broadcast when unusual solar activity is observed, will warn of the probability of occurrence of solar flares and subsequent geomagnetic disturbances. A Special World Interval will be called on 8-hour notice to start at 0000 U. T. the following day, when there is a strong possibility of an ensuing geomagnetic disturbance within the 24 hours following the start of the interval. The communication network for disseminating notices of Alerts and Special World Intervals will be centered at the National Bureau of Standards radio forecasting facility at Fort Belvoir, Virginia.

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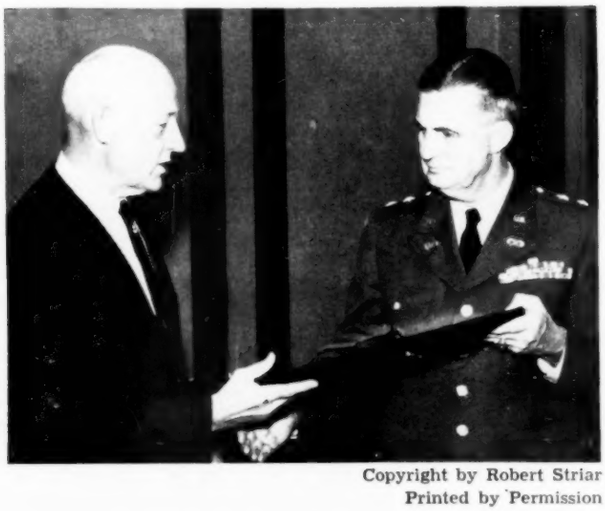
CHEMICAL CORPS NEWS

MCA HONORS CHEMICAL CORPS FOR ITS SAFETY RECORD



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A special Certificate of Commendation for its safety record in 1955 was presented to the Army Chemical Corps by the Manufacturing Chemists' Association, Inc., at a ceremony held at the Army and Navy Club, Washington, D. C., on December 19. The presentation was made by General John E. Hull, USA (Ret.), (at left in picture), president of M.C.A. The Certificate was accepted on behalf of the personnel of the Corps by Major General William M. Creasy, USA., Chief Chemical Officer.

R & D COMMAND NOTES

Brigadier General J. H. Rothschild, Commanding General of the Chemical Corps Research and Development Command, visited Alaska December 7-12, 1956 in connection with cold weather testing of some chemical warfare items. His trip took him to Fort Richardson at Anchorage, Fort Greely, and Fairbanks.

* * *

Abraham S. Bass has joined the staff of the Army Chemical Corps, Research and Development Command, Gravelly Point, Washington, D. C. Mr. Bass, a former staff member of The Capital Chemist, transferred from the U. S. Naval Powder Factory, Indian Head, Maryland, where he has been employed as a supervisory research chemist for over 15 years.

* * *

C. Grant Ash, Research and Development Command, attended an Air Pollution Symposium December 17-21, 1956 at Cincinnati, Ohio.

MR. FULVIO DE ANGELIS

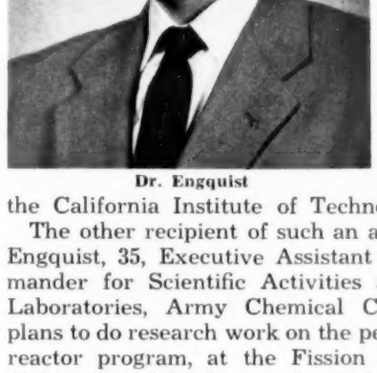
Mr. Fulvio G. De Angelis, 49, who headed the installation branch of the office of the Army Chief Chemical Officer, died of a heart attack, February 9. He was stricken at his home, 3717 N. Glebe Road, Arlington, Va., and was pronounced dead on arrival at Arlington Hospital.

Mr. De Angelis was born in Connellsville, Pa. He was graduated in 1930 with a chemical engineering degree from the University of Pittsburgh. He was a member of Alpha Phi Delta fraternity.

Mr. De Angelis came to Washington in 1940 as a production engineer with the Chemical Warfare Service of the Army. He was assigned to Edgewood Arsenal, Md., and later to the chemical arsenal at Pine Bluff, Ark. He returned to Washington in 1944 to head the installations branch.

Mr. De Angelis was awarded an Army certificate of achievement in 1955.

CHEMICAL CORPS SCIENTISTS GIVEN FELLOWSHIP AWARDS



Dr. Engquist

Two Chemical Corps scientists recently were granted a year's leave of absence and awarded a Research and Study Fellowship by the Secretary of the Army. One is Dr. Ralph E. Lincoln, 44, bacteriologist, chief of the Analysis Branch, Biological Warfare Laboratories, Fort Detrick, Maryland. His plans are to pursue research in bacterial genetics at the California Institute of Technology.

The other recipient of such an award is Mr. Elmer H. Engquist, 35, Executive Assistant to the Deputy Commander for Scientific Activities at Chemical Warfare Laboratories, Army Chemical Center, Maryland. He plans to do research work on the peacetime atomic power reactor program, at the Fission Products Laboratory, University of Michigan, the Oak Ridge and Argonne National Laboratories and at the Knolls Atomic Power Laboratory. Mr. Engquist has a bachelor degree from the University of Illinois and Master of Science degree from Northwestern University.

EDGEWOOD MASTER SERGEANT WINS A FREEDOM'S FOUNDATION AWARD

U.S. Army Photo

With a letter expressing his ideas on the American privilege of voting, a function he has not failed to perform in his 18 years Army service, Master Sergeant Jimmie J. Abbott of Army Chemical Center, Md., recently won a Freedom's Foundation award.

As second place winner the Army contestants (the first place winner not being available for the assignment), Sergeant Abbott was designated to represent the Army in the Foundation's award ceremonies involving all services, which were scheduled to be held at Valley Forge, Pennsylvania, on Washington's Birthday, February 22.

Sgt. Abbott, whose winning letter was entitled "My Vote—Freedom's Privilege," is on duty with the Chemical Corps Board. Son of an Army veteran, he was born in Medford, Oklahoma in 1915. He is one of six brothers all of whom served in the Army in World War II and of whom three, besides himself, are still in the Army. Sergeant Abbott attributes his views on voting and patriotism generally very largely to his mother, now 72, whom he refers to as "a very fine soldier herself." During the War she followed the course of operations closely on maps of every part of the world which she posted on the four walls of her bedroom, drawing in the changes in battle lines so as to keep herself up-to-date.

ATTENDS NIGHT CLASSES TO WIN Ph.D. DEGREE

U.S. Army Photo

By commuting a total of 30,000 miles over a 4-year period from his home at Edgewood, Md., to attend night and week-end classes at the University of Delaware, Dr. Brennie Hackley, Jr., of Army Chemical Laboratories, Army Chemical Center, Md., recently won his Ph.D. degree. In 1949 with a B.S. degree in chemistry from Wilberforce University. Dr. Hackley came to the Army Chemical Center and was assigned technical duty under the Army's Enlisted Scientific and Professional Personnel program. Now in civilian status, he is assistant chief of the Chemotherapy Branch. He has had eleven scientific articles published. Dr. Hackley's wife has a M.S. degree in chemistry from Howard University, Washington, D.C.

"MRS. CHEMICAL CORPS" RETIRES

FORT MEADE, MD.—Mrs. Irene R. Daugherty, known as "Mrs. Chemical Corps" by her co-workers in the Second Army Chemical Section at Fort George G. Meade, Maryland, retired on December 31, after 37 years of Government service. A native of Baltimore, Md., she had been with the Chemical Corps since 1919, one year after the Chemical Warfare Service was organized. On December 11, Brigadier General Thomas N. Griffin, Second Army Chief of Staff, presented to Mrs. Daugherty a Second Army Certificate of Achievement for ". . . her superior accomplishments, outstanding leadership, and exceptional devotion to duty . . ."

N.Y. DISTRICT PRESENTS 1,000 TOYS TO BELLEVUE CHILDREN

The New York Chemical Procurement District, in its second annual "Operation Santa Claus" for the children of Bellevue Hospital, presented more than a thousand toys and a TV set contributed by the employees to Bellevue's children's Recreation Director.

In the picture above,—left to right: Colonel Harold Walmsley, District Commanding Officer; Captain Frances Weir, Adjutant; Mr. Frederick Lightfoot, president of the Welfare Council, and Miss Norma Alessandrini, Director of Children's Recreation Service, Bellevue Hospital.

THE HISTORICAL CORNER

By Brooks E. Kleber
Historical Office, Chemical Corps

"MAY FIGHT AS INFANTRY WHEN REQUIRED"

The phrase, "May fight as infantry when required," provides several Chemical Corps units with their secondary mission. Some may take this for granted, others may think it is odd. Yet the histories of many a chemical company give evidence that this mission is valid and well defined. For example, all of the CWS units which served in the Philippines in the grim months before the fall of Bataan and Corregidor found themselves in the front lines.

The superior number of the Japanese forces which attacked Luzon in December 1941 compelled the American troops to withdraw gradually to the Bataan peninsula on the western coast of the island. Here a valiant defense was staged. In January 1942 the Japanese general, displeased by the slow progress his troops were making down the peninsula, ordered an amphibious attack behind the American lines on the west coast of Bataan. This poorly planned expedition got lost in the dark and far overshot its intended mark. Part of its elements landed on Lapiay and Longoskawayan Points, near the tip of the peninsula. Close by was Mt. Pucot, a 617-foot rise which commanded a strategic road as well as the harbor of Mariveles.

The naval forces at Mariveles, aware of the importance of Mt. Pucot, had established lookouts on its summit some time before. When the Japanese landed on 23 January the alarm was sounded, and an understrength naval battalion was sent to the scene. Thus began what was to be known as the Battle of the Points.

The naval force was led by Commander F. J. Bridget. Bridget took up positions on Mt. Pucot, sized up the situation, and thought it necessary to call for reinforcements. Among the troops sent by the Army commander in the area was a 60-man detachment from the 301st Chemical Depot Company, led by Lt. Colonel L. E. Roemer who commanded the Philippine Chemical Warfare Sub-Depot on Bataan. The 301st was a unit of the Philippine Army, all of which had been ordered into American service in July 1941. It was commanded by American and Filipino officers.

During the night of the 23rd these chemical-infantrymen took positions on the northern slope of Mt. Pucot. They participated through the short, decisive operation which ended six days later with the complete destruction of the enemy. A feature of this battalion was the diversity of the defending forces: marines and sailors, infantry and chemical, American and Filipino. And the battery of 12-inch mortars on Corregidor which shelled Japanese positions on Longos Kawayan represented the first heavy caliber American coast artillery fired in anger since the Civil War.

American-Filipino losses during the engagement totalled 22 dead and 66 wounded; the Japanese force of 300 was wiped out. This victory must have buoyed the spirits of the American troops on Bataan whose experience thus far had been almost exclusively withdrawal. And Mt. Pucot was potentially of great tactical importance; Commander Bridget's report of the battle called attention to the dire consequences which would have resulted if the enemy had taken it.

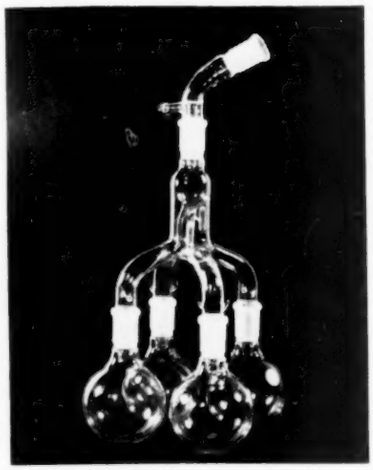
Today, American preparedness practically eliminates the possibility of another Bataan. Still, conditions in the world are anything but peaceful. The chances of fulfilling the above mission are far greater at the outset of a war than at any other time. It would seem that those who provided this secondary mission for Chemical Corps units have been attentive to the lessons that history teaches.

Note: Colonel Roemer died while a prisoner of the Japanese and was buried at sea in January 1945 between Formosa and Japan. Among the American officers taking part in this engagement was 1st Lieut. Charles A. Morgan, Jr., who is currently serving with the Chemical Corps as a lieutenant colonel.

Sources: (1) Rpt. Commander F. J. Bridget, 9 Feb. 42, sub: Action on Longoskawayn Point against the Japanese Forces. In Activities, CWS, Philippine Islands, World War II. (2) Louis Morton, *The Fall of the Philippines*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953). pp. 300-08.

"THE MAGNETIC COW"

A unique separator for vacuum distillation developed by specialists at the Army Chemical Center, Maryland, known as the "Magnetic Cow," permits the cutting of different chemical components into different receivers without disturbing the vacuum.



Previously, separating apparatus employed ground glass connections which had to be loosened each time a chemical compound was to be diverted into a different receiver. Loosening a receiver meant loss of vacuum. Hence the usefulness of this old design was limited.

It was a simple matter to design an airtight separator with a number of receiver flasks connected as a one-piece unit. The real problem concerned the distributor funnel. Somehow this funnel had to be made to revolve at the operator's will so that the liquid components could be diverted into the proper receiver flasks—without direct physical contact. Such contact could only mean disruption of the vacuum.

The solution to the problem was found in an application of magnetic energy. A strip of iron was sealed into a small tube and then attached to the rear of the funnel. The operator could then rotate the funnel at will from *outside* the apparatus with a horseshoe magnet.

As a result of this simple magnetic control, the separator remained airtight. The temperature of the compound being distilled could rise and fractions could be tapped off at various temperatures and pressures without disturbing the vacuum.

The "Magnetic Cow" was designed and built by Mr. H. C. Biggs and Mr. William P. Still. So far as is known, a design of this type is not used commercially.

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